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HDI-IPEC-22-035

10 CFR 50.36(a)
10 CFR 50 Appendix I

May 3, 2022

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Indian Point Energy Center
Renewed Facility License No. DPR-05, DPR-26 and DPR-64
NRC Docket Nos. 50-03, 50-247, and 50-286

Subject: 2021 Annual Radiological Environmental Operating Report

Enclosed with this cover letter is the Annual Radiological Environmental Operating Report for the calendar year 2021 for the Indian Point Energy Center. This submittal is made in accordance with facility Technical Specifications, Appendix A, Section 5.6.2, "Annual Radiological Environmental Operating Report."

This letter contains no new regulatory commitments.

If you have any questions or need further information, please contact Mr. Walter Wittich, IPEC Licensing at 914-254-7212, or me at (856) 797-0900, ext. 3578.

Sincerely,

Jean A. Fleming

Digitally signed by Jean A. Fleming
Date: 2022.05.03 09:25:55 -04'00'

Jean A. Fleming
Vice President, Licensing, Regulatory Affairs and PSA
Holtec Decommissioning International, LLC

Enclosure: 2021 Annual Environmental Protection Plan Report

cc: NRC Senior Project Manager, NRC NMSS
NRC Region I Regional Administrator
NRC Senior Regional Inspector, Indian Point Energy Center
New York State Liaison Officer Designee, NYSERDA
New York State (NYS) Public Service Commission

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ENCLOSURE TO HDI-IPEC-22-035

2021 Annual Radiological Environmental Operating Report

HOLTEC
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Plant: Indian Point Energy Center	Page 1 of 121
	YEAR: 2021
Docket Number: 50-003 (IP1), 50-247 (IP2), 50-286 (IP3)	
Annual Radiological Environmental Operating Report	

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SECTION 1.0

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report summarizes the results of the Radiological Environmental Monitoring Program (REMP) conducted in the vicinity of Indian Point Energy Center (IPEC) during the period from January 1 to December 31, 2021. The Indian Point site consists of Units 1, 2 and 3, which are operated by Holtec Decommissioning International Unit 1 was retired as a generating facility in 1974, and its reactor is no longer operated. Unit 2 was permanently shutdown on April 30th 2020. Unit 3 ceased operation April 30th 2021.

The REMP has been established to monitor/measure the radiation and radioactivity detectable in the environment that may be attributable to the operation of IPEC. This program, initiated in 1958, includes the collection, analysis, and evaluation of radiological data in order to assess the impact of IPEC on the environment.

1.2 SAMPLING AND ANALYSIS

The environmental sampling media collected in the vicinity of IPEC and at distant locations included air particulate filters and charcoal cartridges, soil, drinking water, broad leaf vegetation, river water, shoreline sediment, bottom sediment, aquatic vegetation, fish, and invertebrates.

During 2021 there were 1172 samples collected from the atmospheric, aquatic, and terrestrial environments. This includes 164 exposure measurements which were obtained using environmental thermoluminescent dosimeters (TLDs).

A small number of inadvertent issues were encountered in 2021 in the collection of environmental samples in accordance with the IPEC Offsite Dose Calculation Manual (ODCM). Equipment failures and electrical outages resulted in a small number of instances in which lower than normal sampling volumes were collected at the airborne monitoring stations. A full description of all discrepancies encountered with the environmental monitoring program is presented in the Table B-1 of this report.

There were 1319 analyses performed on the environmental media samples. The analyzes of the 2021 Indian Point environmental samples were performed by several laboratories. Thermoluminescent dosimeters were analyzed by Environmental Dosimetry Company (formerly Stanford Associates) of Sterling, MA. Teledyne Brown Engineering, Inc. of Knoxville, TN performed all the remaining analyses for 2021. Samples were analyzed as required by the IPEC ODCM.

1.3 LAND USE CENSUS

The annual land use census in the vicinity of IPEC was conducted as required by the IPEC ODCM in May through October. No dairy animals whose milk is used for human consumption were identified within 5 miles of the Station during the census. Due to the difficulty of locating individual gardens and determining those having an area greater than 500 square feet, broad leaf sampling was performed. As allowed for in the ODCM, monthly broad leaf sampling may be used in lieu of a garden census.

1.4 SUMMARY OF RESULTS

Samples collected as part of the IPEC REMP continued to contain detectable amounts of naturally-occurring and some man-made radioactive materials. Offsite ambient radiation measurements using environmental TLDs beyond the site boundary ranged between 43 and 61 milli-Roentgens (mR) per year. The range of ambient radiation levels observed with the TLDs is consistent with natural background radiation levels for New York.

Monitoring of the aquatic environment in the area of the station indicated the presence of the following potential station related radioactivity, tritium and cesium-137. Tritium was found in river water at the downstream mixing zone of the discharge canal at levels that were expected from routine plant operation, or other sources such as fallout from past weapons testing. Low-levels of cesium-137 were detected in Hudson River bottom sediment samples downstream of the discharge canal, as well as in the Off Verplanck, Lent's Cove, and Cold Spring locations. The levels detected were consistent with historical findings. No other plant related activity was detected in any offsite samples. The predominant radioactivity for all samples was from non-plant related sources, such as fallout from nuclear weapons tests and naturally occurring radionuclides.

1.5 CONCLUSIONS

The 2021 Radiological Environmental Monitoring Program for IPEC resulted in the collection and analysis of over a thousand environmental samples and measurements. The data obtained were used to determine the impact of IPEC's operation on the environment and on the general public.

In 2021 the only positive detectable plant related activity was three instances of low levels of H-3 detected in river water samples. An evaluation of direct radiation measurements, environmental sample analyses, and dose calculations demonstrates that all applicable federal criteria were met. Furthermore, radiation levels and resulting doses from station operation were a small fraction of those attributed to natural and man-made background radiation.

In summary, the levels of radionuclides in the environment surrounding Indian Point were within the historical ranges, i.e., previous levels resulting from natural and anthropogenic sources for the detected radionuclides. Further, IPEC operations in 2021 did not result in exposure to the public greater than the variability of environmental background levels.

SECTION 2.0

INTRODUCTION

2.0 INTRODUCTION

2.1 Overview

The Radiological Environmental Monitoring Program (REMP) for 2021 performed by Holtec for the Indian Point Energy Center (IPEC) is discussed in this report. Since the operation of a nuclear power plant results in the release of small amounts of radioactivity and low levels of radiation, the Nuclear Regulatory Commission (NRC) requires a program to be established to monitor radiation and radioactivity in the environment (Reference 1). This report, which is submitted to the NRC annually per Indian Point Technical Specifications, summarizes the results of measurements of radiation and radioactivity in the environment in the vicinity of the IPEC and at distant locations during the period January 1 to December 31, 2021.

The REMP is used to measure the direct radiation and the airborne and waterborne pathway activity in the vicinity of the Indian Point site. Direct radiation pathways include radiation from buildings and plant structures, airborne and liquid material that might be released from the plant, cosmic radiation, and the naturally occurring radioactive materials in the ground. Analysis of thermoluminescent dosimeters (TLDs), used to measure direct radiation, indicated that there were no increased radiation levels attributable to plant operations.

The airborne pathway includes measurements of air, drinking water, and broad leaf vegetation samples. The airborne pathway measurements indicated that there was no adverse radiological impact to the surrounding environment attributed to Indian Point Station operations.

The waterborne pathway consists of Hudson River water, fish and invertebrates, aquatic vegetation, bottom sediment, and shoreline sediment. Measurements of the media comprising the waterborne pathway indicated that there was no adverse radiological impact to the surrounding environment attributed to Indian Point Station operations.

These results are reviewed by IPEC's staff and have been reported semiannually or annually to the Nuclear Regulatory Commission and others for over 30 years.

This report contains a description of the REMP for IPEC and the conduct of that program in 2021 as required by the IPEC ODCM. Also included are summaries and discussions of the results of the 2021 program, trend analyses (where appropriate), comparison to historical results and evaluation of any potential impact on the environment. Results of the annual land use census, as well as the inter-laboratory comparison program are included, per the ODCM requirements.

2.2 Site Description

The Indian Point site occupies 239 acres on the east bank of the Hudson River on a point of land at Mile Point 42.6. The site is located in the Village of Buchanan, Westchester County, New York. Three nuclear reactors, Indian Point Unit Nos. 1, 2 and 3, and associated buildings occupy approximately 35 acres. Unit 1 began operation in 1962 and was retired as a generating facility in 1974. Units 2 and 3 began operation 1974 and 1978. Indian Point

Units 1 and 2 are owned by Holtec Decommissioning International Indian Point 2, LLC and Unit 3 is owned by Holtec Decommissioning International Indian Point 3 LLC. All three units are no longer in operation.

2.3 Program Background

Environmental monitoring and surveillance have been conducted at Indian Point since 1958, four years prior to the start-up of Unit 1. The pre-operational program was designed and implemented to determine the background radioactivity and to measure the variations in activity levels from natural and other sources in the vicinity, as well as fallout from atmospheric nuclear weapons tests. Thus, as used in this report, background levels consist of those resulting from both natural and anthropogenic sources of environmental radioactivity. Accumulation of this background data permits the detection and assessment of environmental activity attributable to plant operations.

2.4 Program Objectives

The current environmental monitoring program is designed to meet two primary objectives:

1. To enable the identification and quantification of changes in the radioactivity of the area.
2. To measure radionuclide concentrations in the environment attributable to operations of the Indian Point site.

To identify changes in activity, the environmental sampling schedule requires that analyses be conducted for specific environmental media on a regular basis. The radioactivity profile of the environment is established and monitored through routine evaluation of the analytical results obtained.

The REMP designates sampling locations for the collection of environmental media for analysis. These sample locations are divided into indicator and control locations. Indicator locations are established near the site, where the presence of environmental radioactivity of plant origin is most likely to be detected. Control locations are established farther away (and upwind/upstream, where applicable) from the site, where the level would not generally be affected by plant discharges. The use of indicator and control locations enables the identification of potential sources of detected radioactivity, thus meeting one of the program objectives.

Verification of expected radionuclide concentrations resulting from effluent releases attributable to the site is another objective of the REMP, which is met by meeting the two primary program objectives described above. Verifying projected concentrations through evaluating REMP data can be difficult since the environmental concentrations resulting from plant releases are typically too small to be detected. Plant related radionuclides were detected in 2021 in very low levels; however, residual radioactivity from atmospheric weapons tests and naturally occurring radioactivity were the predominant sources of radioactivity in the samples collected. Analysis of the 2021 REMP sample results confirms that environmental concentrations which could be attributed to radiological effluents were well below regulatory limits.

SECTION 3.0

RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS

3.0 RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS

To achieve the objectives of the REMP and ensure compliance with the ODCM, sampling and analysis of environmental media are performed as outlined in Table A-1 and described in section 3.3.

3.1 Sample Collection

Holtec personnel perform collection of environmental samples for the Indian Point site, with the exception of fish/invertebrate samples. Collection of fish and invertebrate samples is performed by a contracted environmental vendor, Normandeau Associates, Inc.

Environmental media are sampled at the locations specified in Table A-1 and shown in Figures A-1, A-2, and A-3. The samples are analyzed according to criteria established in the ODCM. These requirements include: methods of sample collection; types of sample analysis; minimum sample size required; lower limit of detection, which must be attained for each medium, sample, or analysis type, and environmental concentrations requiring special reports.

Table A-1 provides the sampling station number, location, sector, and distance from Indian Point, sample designation code, and sample type. This table gives the complete listing of sample locations used in the 2021 REMP.

Three maps are provided to show the locations of REMP sampling. Figure A-1 shows the sampling locations within two miles of Indian Point. Figures A-2 and A-3 show the sampling locations within ten miles of Indian Point.

3.2 Sample Analysis

The analysis of the 2021 Indian Point environmental samples was performed by several laboratories. Thermoluminescent dosimeters were analyzed by Environmental Dosimetry Company (formerly Stanford Associates) of Sterling, MA. Teledyne Brown Engineering, Inc. of Knoxville, TN performed all the remaining analyses.

3.3 Sample Collection and Analysis Methodology

3.3.1 Direct Radiation

Direct gamma radiation is measured using integrating calcium sulfate thermoluminescent dosimeters (TLDs), which provide cumulative measurements of radiation exposure (i.e., total integrated exposures in milli-roentgen, mR) for a given period. The area surrounding the Indian Point site is divided into 16 compass sectors. Each sector has two TLD sample locations. The inner ring is located near the site boundary at approximately 1 mile (1.6 km). The outer ring is located at approximately 5 miles (8 km) from the site (6.7- 8.0 km), see Figures A-1 and A-2. Additional TLD locations include a control location at Roseton (20.7 miles north) and eight locations of special interest. In total, there are 41 TLD sample sites, designated DR-1 through DR-41, with two TLDs placed at each site. TLDs are collected and processed on a quarterly basis. The results are reported as mR per standard quarter (91 days). The data reported is the average of the two TLDs from each sample site.

3.3.2 Airborne Particulates and Radioiodine

Air samples were taken at eight locations varying in distance from 0.28 to 20.7 miles (0.5 to 33 km) from the plant. These locations represent one control at sampling station 23 (A5) and seven indicator locations. These indicator locations are at sampling stations 4 (A1), 5 (A4), 27, 29, 94 (A2), 95 (A3), and 108. The locations are shown on Figures A-1, A-2, and A-3. The air samples are collected continuously by means of fixed air particulate filters followed by in-line charcoal cartridges. Both filters and cartridges are changed on a weekly basis. The filters are analyzed for gross beta and the cartridge samples for radioiodine. In addition, gamma spectroscopy analysis (GSA) is performed on quarterly composites of the air particulate filters.

3.3.3 Drinking Water

Samples of drinking water are collected monthly from the Camp Field Reservoir (3.4 miles NE, sample station 7, sample designation Wb1) and New Croton Reservoir (6.3 miles SE, sample station 8); see Figure A-2 and Figure A-3. Each monthly sample is approximately 4 liters and is analyzed for gross beta and gamma-emitting radionuclides. Monthly samples are composited quarterly and analyzed for tritium.

3.3.4 Soil

Soil samples are collected from two indicator locations (sampling stations 94 and 95), and one control location (23) on an annual basis; see Figure A-3. They are approximately 2 kg in size and consist of about twenty 2-inch deep cores. The soil samples are analyzed by gamma spectroscopy.

3.3.5 Broad Leaf Vegetation

Broad Leaf vegetation samples are collected from three locations during the growing season. The indicator locations are sampling stations 94 (Ic2) and 95 (Ic1), and the control location is at sampling station 23 (Ic3). See Figures A-1 and A-2. The samples are collected monthly, when available, and analyzed by gamma spectroscopy. These samples consist of at least 1 kg of leafy vegetation and are used in the assessment of the food product and milk ingestion pathways.

3.3.6 Hudson River Water

Hudson River water sampling is performed continuously at a point exterior to the discharge canal where Hudson River water and water from the discharge canal mix (sampling station 10, Wa2); see Figure A-1. Samples were also collected continuously at a control station 23 Roseton (Figure A-2 and A-3). An automatic composite sampler is used to take representative samples. On a weekly basis, accumulated samples are taken from both sample points. These weekly river water samples are composited for monthly gamma spectroscopy analysis and quarterly for tritium analysis.

3.3.7 Hudson River Bottom Sediment

Bottom sediment and benthos are sampled at four locations: three indicator locations (sampling stations 10, 17, and 28) and one control location (84), along the Hudson River, once each spring and summer; see Figure A-3. These samples are obtained using a

Peterson grab sampler or similar instrument. The bottom sediment samples are analyzed by gamma spectroscopy.

3.3.8 Hudson River Shoreline Soil

Shoreline soil samples are collected at three indicator and two control locations along the Hudson River. The indicator locations are at sampling stations 53 (Wc1), 28, and 17. The control locations are at sampling stations 50 (Wc2) and 84. Figures A-1, A-2, and A-3 show these locations. The samples are gathered at a level above low tide and below high tide and are approximately 2-kg grab samples. These samples are collected at greater than 90 days apart and are analyzed by gamma spectroscopy and for strontium-90.

3.3.9 Hudson River Aquatic Vegetation

During the spring and summer, aquatic vegetation samples are collected from the Hudson River at two indicator locations (sampling stations 17 and 28) and one control location (84); see Figure A-3. Samples of aquatic vegetation are obtained depending on sample availability. These samples are analyzed by gamma spectroscopy.

3.3.10 Fish and Invertebrates

Fish and invertebrate samples are obtained from the Hudson River at locations upstream and downstream of the plant discharge. The indicator location (downstream sample point) is designated as sampling station 25 (Ib1), and a second sampling station 107 is located further downstream. The control location (upstream) is at sampling station 23 (Ib2). See Figures A-1 and A-2. These samples are collected in season or semiannually if they are not seasonal. The fish and invertebrates sampled are analyzed by gamma spectroscopy as well as for strontium-90 and for nickel-63.

3.3.11 Land Use Census

In addition to the sampling outlined in Table A-1, there is an environmental surveillance requirement that an annual land use census be performed. Each year a land use census consisting of milch animal and residence surveys is conducted during the growing season to determine the current utilization of land within 5 miles (8 km) of the site. These surveys are used to determine whether there are changes in existing conditions that warrant changing the sampling program. The results of the census are discussed in Section 4.11.

For example, the milch animal census is used to identify animals producing milk for human consumption within 5 miles (8 km) of Indian Point. This census consists of visual field surveys of the areas where a high probability of milch animals exists and confirmation through New York State records or with personnel such as feed suppliers who deal with farm animals and dairy associations.

Visual inspections are made of the 5-mile area around the Indian Point Site during routine sample collections and emergency plan equipment inspections in the area throughout the year. An extensive land survey is conducted of the 5-mile area in an attempt to identify new residential areas, commercial developments and to identify milch animals in pasture.

A garden census is not required, since the ODCM allows sampling of vegetation in two sectors near the site boundary in lieu of a garden census. The sectors are chosen to be in the pre-dominant wind directions with the highest predicted deposition rates.

3.4 Statistical Methodology

There are several statistical calculation methodologies used in evaluating the data from the Indian Point REMP. These methods include determination of Lower Limits of Detection (LLD) and the Minimum Detectable Concentration (MDC), and estimation of the mean and associated propagated error.

3.4.1 Lower Limit of Detection (LLD)

The LLD is the smallest concentration of radioactive material in a sample that will yield a net count above system background, and be detected with 95% probability, with a 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{\frac{2.71}{T_s} + 3.29\, s_b * \sqrt{1+(\frac{T_b}{T_s})}}{E * V * k * Y * e^{-\lambda t}}$$

Where:

LLD = The lower limit of detection as defined above (as picocurie per unit mass or volume)

Ts = The sample counting time in minutes

s_b = The standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

T_b = The background count time in minutes

E = The counting efficiency (as counts per transformation)

V = The sample size (in units of mass or volume)

k = A constant for the number of transformations per minute per unit of activity (normally, 2.22E+6 dpm per uCi)

Y = The fractional radiochemical yield (when applicable)

λ = The radioactive decay constant for the particular radionuclide

t = The elapsed time between midpoint of sample collection and time of counting

Note: The above LLD formula accounts for differing background and sample count times. The Radiological Environmental Monitoring Program, REMP, may use an LLD formula that assumes equal background and sample count times, when appropriate. The constants 2.71 and 3.29 and the general LLD equation were derived from References 2 and 3.

The value of S_b used in the calculation of the LLD for a detection system shall be based on the actual observed variance of the background counting rate or of the counting rate of the

blank samples (as appropriate) rather than on an unverified theoretically predicted variance. In calculating the LLD for a radionuclide determined by gamma ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples. Typical values of E, V, Y, and t shall be used in the calculation. The background count rate is calculated from the background counts that are determined by a separate background count or in the case of gamma ray spectroscopy, from adjacent channels of the energy band of the gamma ray peak used for the quantitative analysis for that radionuclide.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement process and not as an a posteriori (after the fact) limit for a particular measurement. To document the post priori (after the fact) measurement statistics, the MDC is calculated after the measurement using the same equation as above.

To handle the a posteriori problem, a decision level must be defined. To minimize the number of false positives, a value is not considered positive unless it is greater than the MDC or 3 times the total standard deviation of the post priori measurement, where MDC is

the post priori (after the fact) measurement statistic calculated similar to the LLD equation listed above (for $T_b = T_s$, the term $3.29\ s_b * [(1 + (T_b / T_s))^{1/2}] = 4.66\ s_b$).

The ODCM required lower limits of detection (LLD) for Indian Point sample analyses are presented in Table A-2. These required lower limits of detection are not the same as the lower limits of detection or critical levels actually achieved by the laboratory. The laboratory's lower limits of detection and critical levels must be equal to or lower than the required levels presented in Table A-2.

Table A-3 provides the reporting level for radioactivity in various media. Sample results that exceed these levels and are due to plant operations require that a special report be submitted to the NRC.

3.4.2 Table Statistics

The averages shown in the summary table (Table B-2) are the averages of the positive values in accordance with the NRC's Branch Technical Position (BTP) to Regulatory Guide 4.8 (Reference 4). Samples with "<" values are not included in the averages.

It should be noted that this statistic for the mean using only positive values tends to strongly bias the average high, particularly when only a few of the data are measurably positive. The REMP data show few positive values; thus the corresponding means are biased high. Exceptions to this include direct radiation measured by TLDs and gross beta radioactivity in air, which show positive monitoring results throughout the year.

The historical data tables contain the annual averages of the positive values for each year for 2011 through 2021. The historical averages are calculated using only the positive values presented for 2011 through 2020. The 2021 average values are included in these historic tables for purposes of comparison.

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
3	DR8	Service Center Building	Onsite - 0.35 Mi (SSE) at 158°	Direct Gamma
4	A1	Algonquin Gas Line	Onsite - 0.28 Mi (SW) at 234°	Air Particulate
	A1			Radioiodine
5	A4	NYU Tower	Onsite - 0.88 Mi (SSW) at 208°	Air Particulate
	A4			Radioiodine
	DR10			Direct Gamma
7	Wb1	Camp Field Reservoir	3.4 Mi (NE) at 51°	Drinking Water
8	**	Croton Reservoir	6.3 Mi (SE) at 124°	Drinking Water
10	Wa2	Discharge Canal (Mixing Zone)	Onsite - 0.3 Mi (WSW) at 249°	HR Water
	**			HR Bottom Sediment
14	DR7	Water Meter House	Onsite - 0.3 Mi (SE) at 133°	Direct Gamma
17	**	Off Verplanck	1.5 Mi (SSW) at 202.5°	HR Aquatic Vegetation
	**			HR Shoreline Soil
	**			HR Bottom Sediment
20	DR38	Cortlandt Yacht Club (AKA Montrose Marina)	1.5 Mi (S) at 180°	Direct Gamma
23	23	Roseton*	20.7 Mi (N) at 357°	HR Water
	A5			Air Particulate
	A5			Radioiodine
	DR40			Direct Gamma
	Ic3			Broad Leaf Vegetation
	**			Soil
	Ib2			Fish & Invertebrates
25	Ib1	Downstream	Downstream	Fish & Invertebrates
27	**	Croton Point	6.36 Mi (SSE) at 156°	Air Particulate
	**			Radioiodine
	DR41			Direct Gamma
28	**	Lent's Cove	0.45 Mi (ENE) at 069°	HR Shoreline Soil
	DR4			Direct Gamma
	**			HR Bottom Sediment
	**			HR Aquatic Vegetation
29	**	Grassy Point	3.37 Mi (SSW) at 196°	Air Particulate
	**			Radioiodine
	DR39			Direct Gamma
33	DR33	Hamilton Street (Substation)	2.88 Mi (NE) at 053°	Direct Gamma
34	DR9	South East Corner of Site	Onsite - 0.52 Mi (S) at 179°	Direct Gamma
35	DR5	Broadway & Bleakley Avenue	Onsite - 0.37 Mi (E) at 092°	Direct Gamma
38	DR34	Furnace Dock (Substation)	3.43 Mi (SE) at 141°	Direct Gamma

* = Control location

** = Locations listed do not have sample designation locations specified in the ODCM

HR = Hudson River

***= In 2021 Air sampler station 44 Peekskill was relocated to 108 Telcom. Bldg.

****= In 2021 River water station 9 Plant Inlet (Hudson River Intake) was moved to Roseton.

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
44**	**	Peekskill Gas Holder Bldg	1.84 Mi (NE) at 052°	Air Particulate
	**			Radioiodine
50	Wc2	Manitou Inlet*	4.48 Mi (NNW) at 347°	HR Shoreline Soil
53	Wc1	White Beach	0.92 Mi (SW) at 226°	HR Shoreline Soil
	DR11			Direct Gamma
56	DR37	Verplanck - Broadway & 6th Street	1.25 Mi (SSW) at 202°	Direct Gamma
57	DR1	Roa Hook	2 Mi (N) at 005°	Direct Gamma
58	DR17	Route 9D - Garrison	5.41 Mi (N) at 358°	Direct Gamma
59	DR2	Old Pemart Avenue	1.8 Mi (NNE) at 032°	Direct Gamma
60	DR18	Gallows Hill Road & Sprout Brook Road	5.02 Mi (NNE) at 029°	Direct Gamma
61	DR36	Lower South Street & Franklin Street	1.3 Mi (NE) at 052°	Direct Gamma
62	DR19	Westbrook Drive (near the Community Center)	5.03 Mi (NE) at 062°	Direct Gamma
64	DR20	Lincoln Road - Cortlandt (School Parking Lot)	4.6 Mi (ENE) at 067°	Direct Gamma
66	DR21	Croton Avenue - Cortlandt	4.87 Mi (E) at 083°	Direct Gamma
67	DR22	Colabaugh Pond Road - Cortlandt	4.5 Mi (ESE) at 114°	Direct Gamma
69	DR23	Mt. Airy & Windsor Road	4.97 Mi (SE) at 127°	Direct Gamma
71	DR25	Warren Ave - Haverstraw	4.83 Mi (S) at 188°	Direct Gamma
72	DR26	Railroad Avenue & 9W - Haverstraw	4.53 Mi (SSW) at 203°	Direct Gamma
73	DR27	Willow Grove Road & Captain Faldermeyer Drive	4.97 Mi (SW) at 226°	Direct Gamma
74	DR12	West Shore Drive - South	1.59 Mi (WSW) at 252°	Direct Gamma
75	DR31	Palisades Parkway	4.65 Mi (NW) at 225°	Direct Gamma
76	DR13	West Shore Drive - North	1.21 Mi (W) at 276°	Direct Gamma
77	DR29	Palisades Parkway	4.15 Mi (W) at 272°	Direct Gamma
78	DR14	Rt. 9W across from R/S #14	1.2 Mi (WNW) at 295°	Direct Gamma
79	DR30	Anthony Wayne Park	4.57 Mi (WNW) at 296°	Direct Gamma
80	DR15	Route 9W South of Ayers Road	1.02 Mi (NW) at 317°	Direct Gamma
81	DR-28	Palisades Pkwy - Lake Welch Exit	4.96 Mi (WSW) at 310°	Direct Gamma
82	DR16	Ayers Road	1.01 Mi (NNW) at 334°	Direct Gamma
83	DR32	Route 9W - Fort Montgomery	4.82 Mi (NNW) at 339°	Direct Gamma
84	**	Cold Spring *	10.88 Mi (N) at 356°	HR Aquatic Vegetation
	**			HR Shoreline Soil
	**			HR Bottom Sediment
88	DR6	Reuter Stokes Pole #6	0.32 Mi (ESE) at 118°	Direct Gamma
89	DR35	Highland Ave & Sprout Brook Road (near rock cut)	2.89 Mi (NNE) at 025°	Direct Gamma

* = Control location

** = Locations listed do not have sample designation locations specified in the ODCM

HR = Hudson River

***= In 2021 Air sampler station 44 Peekskill was relocated to 108 Telcom. Bldg.

****= In 2021 River water station 9 Plant Inlet (Hudson River Intake) was moved to Roseton.

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
90	DR3	Charles Point	0.88 Mi (NE) at 047°	Direct Gamma
92	DR24	Warren Road - Cortlandt	3.84 Mi (SSE) at 149°	Direct Gamma
94	A2	IPEC Training Center	Onsite- 0.39 Mi (S) at 193°	Air Particulate
	A2			Radioiodine
	Ic2			Broad Leaf Vegetation
	**			Soil
95	A3	Meteorological Tower	Onsite - 0.46 Mi (SSW) at 208°	Air Particulate
	A3			Radioiodine
	Ic1			Broad Leaf Vegetation
	**			Soil
107	**	Vicinity of Haverstraw Bay	2.5 mi SSW (downstream)	Fish & Invertebrates
108***	**	Telecomm Bldg.	0.36 mi ESE	Air Particulate
	**			Radioiodine

* = Control location

** = Locations listed do not have sample designation locations specified in the ODCM

HR = Hudson River

***= In 2021 Air sampler station 44 Peekskill was relocated to 108 Telcom. Bldg.

****= In 2021 River water station 9 Plant Inlet (Hudson River Intake) was moved to Roseton.

FIGURE A-1

SAMPLING LOCATIONS
Within Two Miles of Indian Point

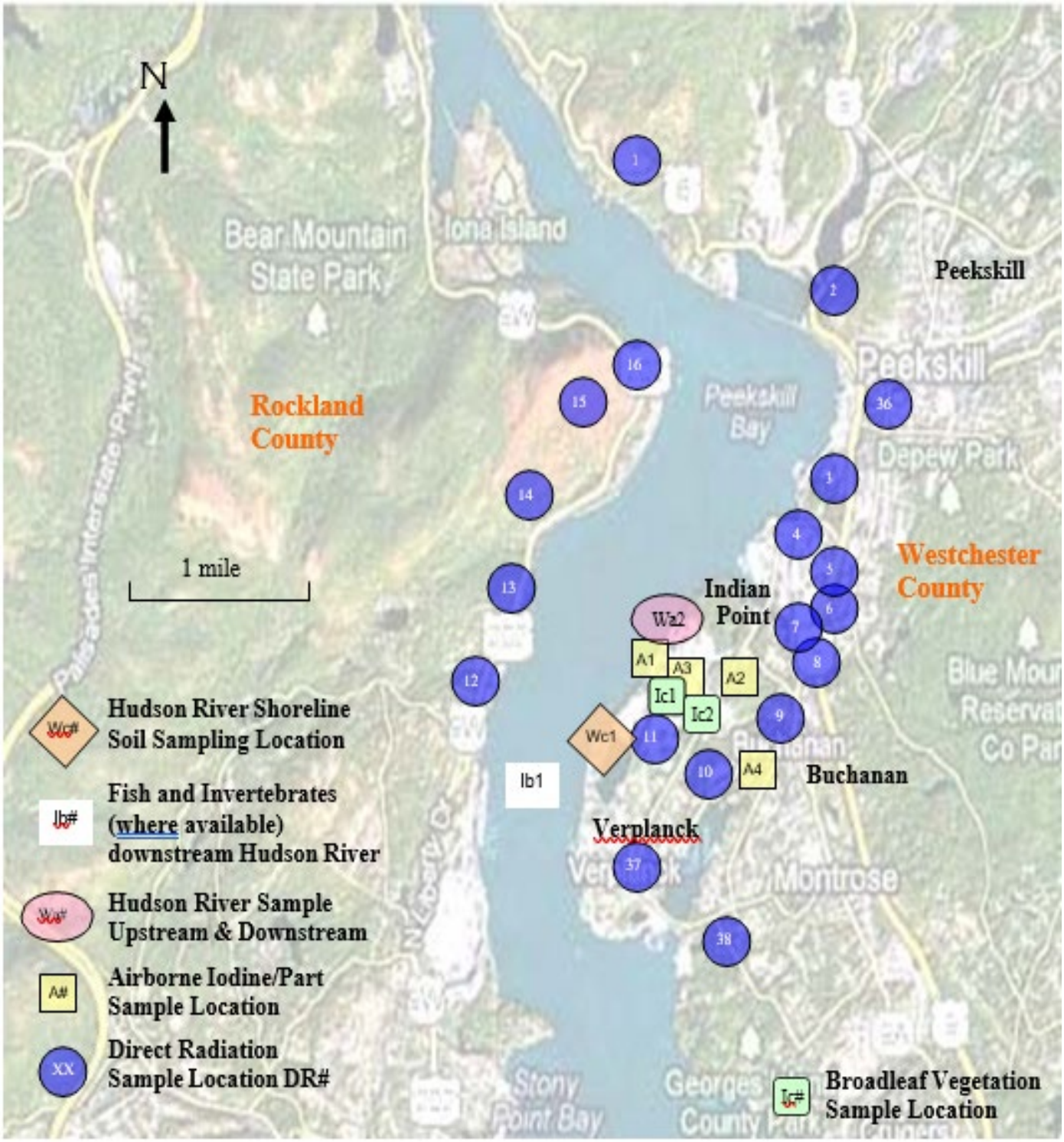


FIGURE A-2

SAMPLING LOCATIONS
Greater than Two Miles from Indian Point

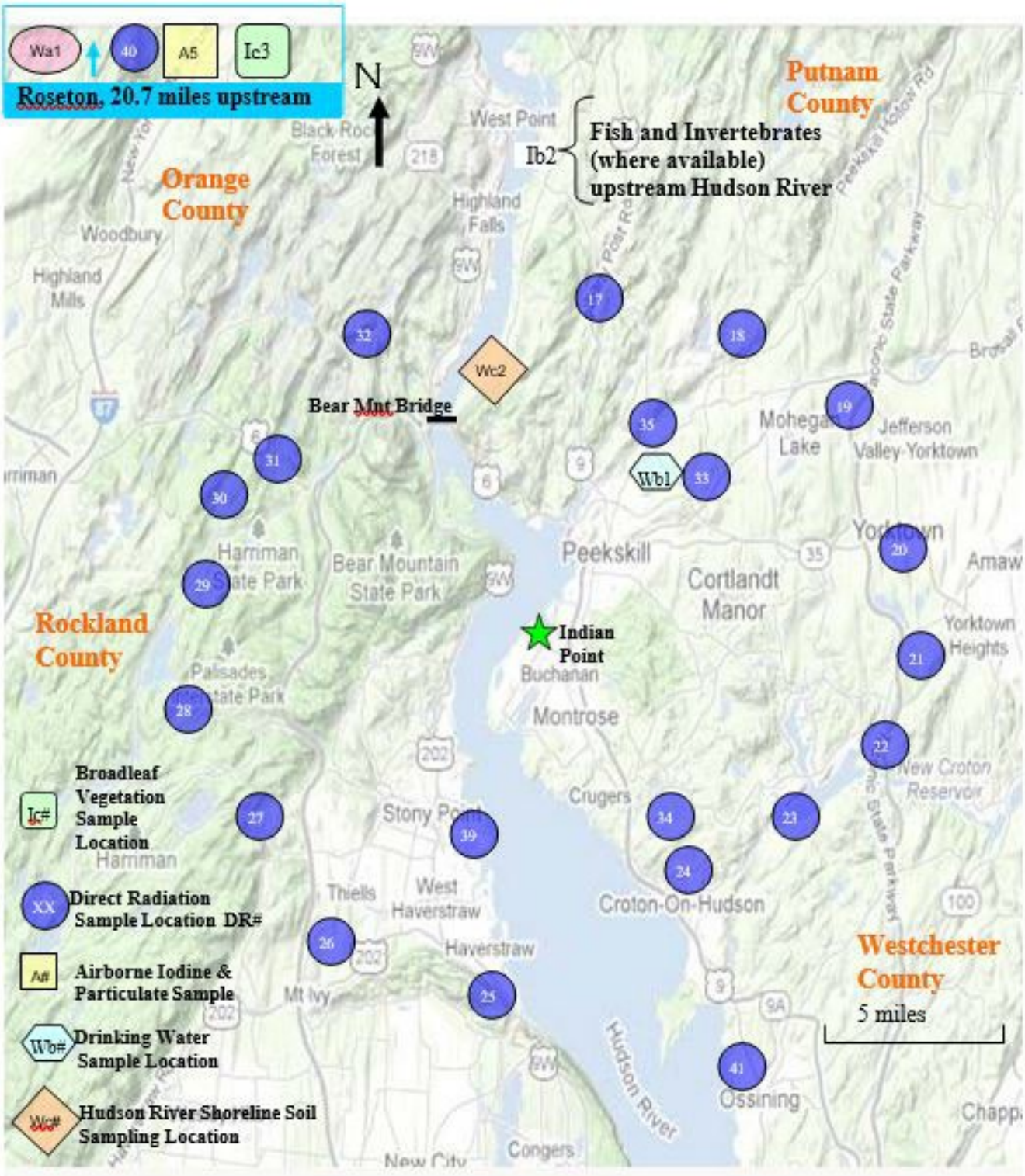


FIGURE A-3

SAMPLING LOCATIONS
Additional Sampling Locations

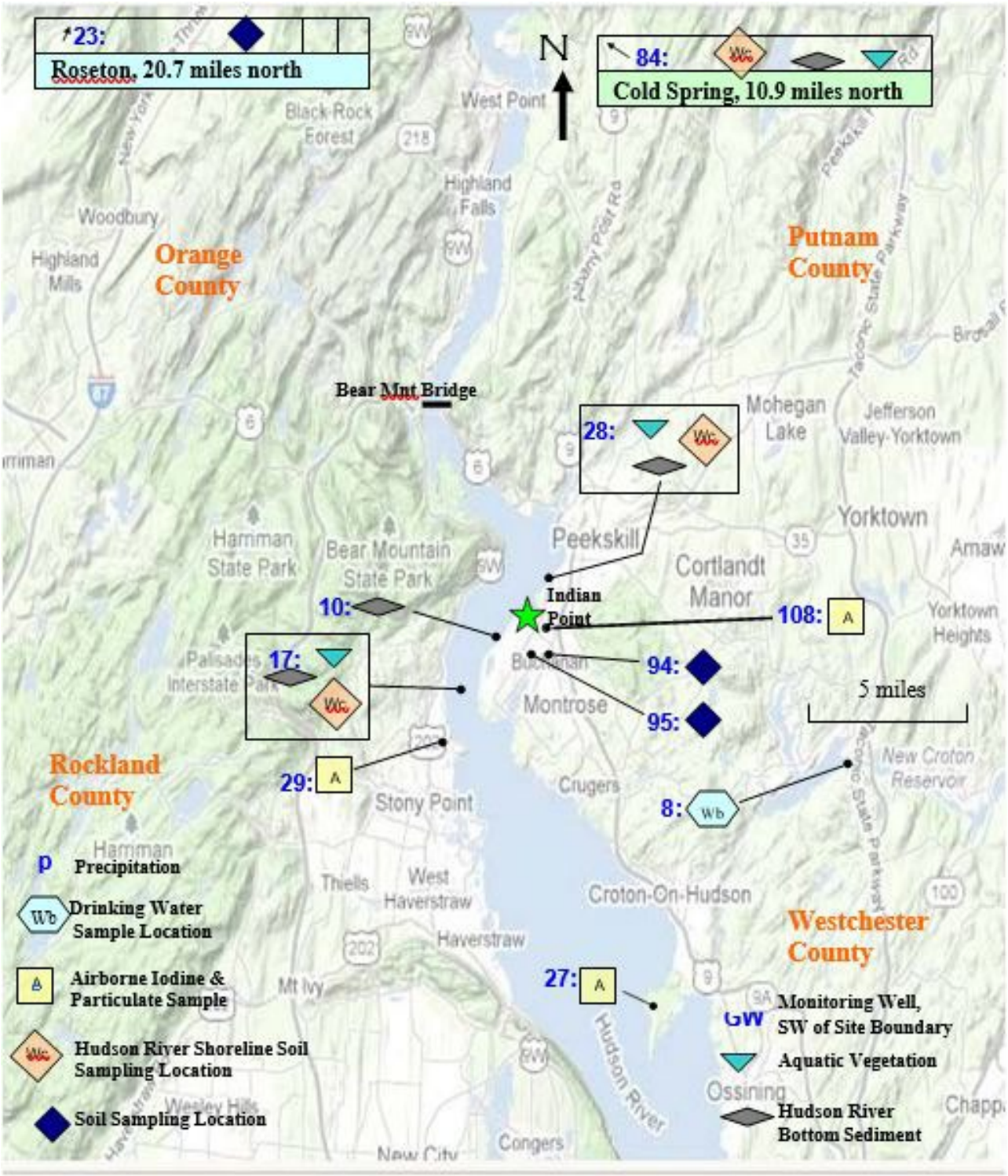


TABLE A-2

LOWER LIMIT OF DETECTION (LLD) REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

RADIONUCLIDE ANALYSIS	WATER (pCi/L)	AIRBORNE PARTIUCLATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/L)	FOOD PRODUCTS (pCi/kg, wet)	SOIL or SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2,000 (d)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Ni-63 (f)	30		100			
Zn-65	30		260			
Sr-90 (f)	1		5			50
Zr-95	30					
Nb-95	15					
I-131	1 (d)	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

TABLE A-2

LOWER LIMIT OF DETECTION (LLD) REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

Table Notation

(a) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to the ODCM.

(b) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

(c) The LLD is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a “real” signal.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable.

In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to the ODCM.

(d) These LLDs are for drinking water samples. If no drinking water pathway exists, the LLDs may be increased to 3,000 pCi/liter for H-3 and 15 pCi/liter for I-131.

(e) These required lower limits of detection are associated only with the REMP requirements. The Radiological Ground Water Monitoring Program may involve unique reporting level criteria, independent of the REMP, and defined in station procedures.

(f) Sr-90 and Ni-63 are included in this table due to their historical presence in ground water and possible migration to the environment.

TABLE A-3

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

RADIONUCLIDE ANALYSIS	WATER (pCi/L)	AIRBORNE PARTIUCLATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/L)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000 *				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Ni-63 ***	300		1,000		
Zn-65	300		20,000		
Sr-90 ***	8*		40		
Zr-95	400				
Nb-95	400				
I-131	2 *	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-140	200			300	
La-140	200			300	

* Values provided are for drinking water pathways. If no drinking water pathway exists, higher values are allowed, as follows:

H-3 30,000 pCi/L (This is a 40 CFR 141 value)

Sr-90 12 pCi/L

I-131 20 pCi/L

** These reporting levels are associated only with the REMP requirements. The Radiological Ground Water Monitoring Program may involve unique reporting level criteria, independent of the REMP, and defined in station procedures.

*** Sr-90 and Ni-63 are included in this table due to their historical presence in ground water and possible migration to the environment

SECTION 4.0

INTERPRETATION AND TRENDS OF RESULTS

4.0 INTERPRETATION AND TRENDS OF RESULTS

The 2021 Radiological Environmental Monitoring Program (REMP) was conducted in accordance with Indian Point's Offsite Dose Calculation Manual ODCM. The ODCM contains requirements for the number and distribution of sampling locations, the types of samples to be collected, and the types of analyses to be performed for measurement of radioactivity.

The REMP at Indian Point includes measurements of radioactivity levels in the following environmental pathways.

Direct Gamma Radiation	Drinking Water
Broad Leaf Vegetation	Hudson River Water
Bottom Sediment	Shoreline Soil
Aquatic Vegetation	Fish and Invertebrates
Airborne Particulates and Radioiodine	Soil

An annual land use and milch animal census is also part of the REMP.

To evaluate the contribution of plant operations to environmental radioactivity levels, other man-made and natural sources of environmental radioactivity, as well as the aggregate of past monitoring data, must be considered. It is not merely the detection of a radionuclide, but the evaluation of the location, magnitude, source, and history of its detection that determines its significance. Therefore, we have reported the data collected in 2021 and assessed the significance of the findings.

A summary of the results of the 2021 REMP is presented in Table B-2. This Table lists the mean and range of all positive results obtained for each of the media sampled at ODCM indicator and control locations. Discussions of these results and their evaluations are provided below.

The radionuclides detected in the environment can be grouped into three categories: (1) naturally occurring radionuclides; (2) radionuclides resulting from weapons testing and other non-plant related, anthropogenic sources; and (3) radionuclides that could be related to plant operations.

The environment contains a broad inventory of naturally occurring radionuclides which can be classified as, cosmic ray induced (e.g., Be-7) or geologically derived (e.g., Ra-226 and progeny, Th-228 and progeny, and K-40.) These radionuclides constitute the majority of the background radiation source and thus account for a majority of the annual background dose detected. Since the detected concentrations of these radionuclides were consistent at indicator and control locations, and unrelated to plant operations, their presence is noted only in the data tables and will not be discussed further.

The second group of radionuclides detected in 2021 consists of those resulting from past weapons testing in the earth's atmosphere. The more recent contamination events resulting from the Chernobyl and Fukushima accidents only indicated detectable activity shortly after their occurrences (Reference 5). However, weapons testing in the 1950's and 1960's resulted in a significant atmospheric radionuclide inventory, which, in turn, still contributes to the

concentrations in the ecological systems. Although reduced in frequency, atmospheric weapons testing continued into the 1980's. The resultant radionuclide inventory of some radionuclides, although diminishing with time (e.g., through radioactive decay and natural dispersion processes), remains detectable.

In 2021, the detected radionuclides that may be attributable to past atmospheric weapons testing consisted of Cs-137 in several media. The levels detected were consistent with the historical levels of radionuclides resulting from weapons tests as measured in previous years.

The final group of radionuclides detected by the 2021 REMP comprises those that may be attributable to current plant operations. During 2021, Cs-137 and Tritium were the only potentially plant-related radionuclides detected in any environmental samples.

H-3 may be present in the local environment due to either natural occurrence, other man-made sources, or as a result of plant operations. Natural occurrence is very low (on the order of approximately 5 pCi/liter - well below typical detectable levels). The major source of H-3 is typically from above ground nuclear weapons testing, in the range of 50 to 150 pCi/liter). Other sources include weapons production and industrial uses where levels are highly dependent on the release rates and distance from the source term. One such industrial source is nuclear power plant operation. In 2021, very low levels of H-3 were detected in three river water samples.

Cs-137 is ubiquitous in the environment from atmospheric testing debris and a lesser amount from the Chernobyl accident. In 2021, there were six detections of Cs-137 in bottom sediment at indicator and control locations. In all cases, the Cs-137 concentrations, when detected, were consistent with historical values.

Strontium-90 (Sr-90) may also be present in the environment from atmospheric testing debris. Sr-90 was not detected in any of the fish, invertebrate, or shoreline soil.

I-131 is also produced in fission reactors, but can result from non-plant related anthropogenic sources, e.g., medical administrations, such as has been noted in previous years. I-131 was not detected in 2021 in aquatic or terrestrial vegetation indicator and control locations.

Co-58 and Co-60 are activation/corrosion products also related to plant operations. They are produced by neutron activation in the reactor core. Co-58 has a much shorter half-life than Co-60. If Co-58 and Co-60 are concurrently detected in environmental samples, then the source of these radionuclides is more likely the result of recent releases. When significant concentrations of Co-60 are detected but no Co-58, there is an increased likelihood that the Co-60 is due to residual Co-60 from past operations. There was no Co-58 or Co-60 detected in the 2021 REMP, although they were observed in historical data.

In the following sections, a summary of the results of the 2021 REMP is presented by sample medium and the significance of any positive findings discussed. As previously mentioned, Table B-2 provides an annual summary of the following media.

4.1 Direct Radiation

The environmental TLDs used to measure the direct radiation were TLDs supplied and processed by Environmental Dosimetry Company. In 2021, the TLD program produced a

consistent picture of ambient background radiation levels in the vicinity of the Indian Point Station. A summary of the annual TLD data is provided in Table B-2 and all the TLD data are presented in Tables B-3, B-4 and B-5. TLD sample site DR-40 is the control site for the direct radiation (DR) series of measurements.

Table B-3 provides the quarterly and annual average reported doses in mR per standard quarter for each of the direct radiation sample points, DR-1 through DR-41. Table B-4 provides the mean, standard deviation, minimum and maximum values in mR per year for the years 2012 through 2020. The 2021 means are also presented in Table B-4. Table B-5 presents the 2021 TLD data for the inner ring and outer ring of TLDs. The table also provides the sector for each of the DR sample points.

The 2021 mean value for the indicator direct radiation sample points was 13.2 mR per standard quarter – which is consistent with historical values. At those locations where the 2021 mean value was higher than historical means, they are within historical bounds for the respective locations.

The DR sample locations are arranged so that there are two concentric rings of TLDs around the Indian Point site. The inner ring (DR-1 to DR-16) is close to the site boundary. The outer ring (DR-17 to DR-32) has a radius of approximately 5 miles from the three Indian Point units. The results of the annual totals for these two rings of TLDs are provided in Table B-5. The annual average for the inner ring was 13.2 mR per standard quarter and also average for the outer ring was 13.3 mR per standard quarter. The control location average for 2021 was 14.1 mR per standard quarter.

Table C-1 and Figure C-1 present the 10-year historical averages for the inner and outer rings of TLDs. The 2021 averages are consistent with the historical data. The 2021 and previous years' data show that there is no measurable direct radiation in the environment due to the operation of the Indian Point site.

4.2 Airborne Particulates and Radioiodine

The results of the analyses of weekly air particulate filter samples for gross beta activity are presented in Table B-6 and the weekly charcoal cartridge analytical results are presented in Table B-7.

Gross beta activity was found in air particulate samples throughout the year at all indicator and control locations. The average gross beta activity for the seven indicator air sample locations was 0.014 pCi/m^3 and the average for the control location was 0.014 pCi/m^3. The activities detected were consistent for all locations, with no significant differences in gross beta activity in any sample due to location.

The results of the gamma spectral analyses (GSA) of the quarterly composites of these samples are shown in Table B-8. These quarterly composite air samples indicate that no reactor-related radionuclides were detected and that only Be-7, a naturally-occurring radionuclide was present at detectable levels.

The mean annual gross beta concentrations and Cs-137 concentrations in air for the past 10 years are presented in Table C-2. From this table and Figure C-2, it can be seen that the

average 2021 gross beta concentration was consistent with historical levels. Cs-137 has not been detected since 1987. This is consistent with the trend of decreasing ambient Cs-137 concentrations in recent years.

From the data, it can be seen that no airborne radioactivity attributable to the operation of Indian Point was detected in 2021.

4.3 Drinking Water

Results of the gross beta, tritium and gamma spectroscopy analyses of the monthly drinking water samples are in Table B-9. Other than Gross Beta activity consistent with historical values, no radioactivity was detected in drinking water samples. This has historically been the case for the radionuclide results for this media. Operation of the Indian Point units had no detectable radiological impact on drinking water.

4.4 Soil

Table B-10 contains the results of the soil samples for 2021. There were no plant related nuclides detected in the 2021 samples.

4.5 Broad Leaf Vegetation

Data from analysis of the 2021 samples are presented in Table B-11. Table C-6 contains an historical summary and Figure C-6 is an illustration of the broad leaf vegetation analysis results. There were no plant related nuclides detected in the 2021 samples. The detection of low levels of Cs-137 has occurred sporadically at indicator locations at relatively low concentrations for the past ten years, most likely the result of previous atmospheric weapons testing.

4.6 Hudson River Water

Data resulting from analysis of monthly Hudson River water samples for gamma emitters and quarterly composites of H-3 are presented in Tables B-12.

The only plant related activity detected was H-3; detected at low levels in three indicator samples. The levels are consistent with occasional historical detection of H-3 related to plant operation. Table C-3 shows historical H-3 concentrations at the plant inlet and discharge points. Table C-8 contains a comparison of H-3 detected at the plant discharge (Hudson River Water mixing point) versus calculated quarterly average effluents concentrations. The data in table C-8 provides assurance that the REMP is indeed providing verification of the calculated radionuclide concentrations resulting from effluent releases attributable to the site.

4.7 Hudson River Bottom Sediment

Table B-13 contains the results of the analysis of bottom sediment samples for 2021. Cesium-137 was detected in five of six indicator station samples, and one of two control location samples. Detection of positive levels of Cs-137 in river bottom sediment is not unusual. Cs-137 is often detected in the control location sediments and therefore not likely due to plant releases.

Historical levels of Cs-137 in bottom sediment samples are shown in table C-9 and figure C-9. This data shows the continued detection of Cs-137 in bottom sediment samples at varying levels, and demonstrates that the levels observed during 2021 sampling are within the range of levels identified in historical samples.

4.8 Hudson River Shoreline Soil

Table B-14 contains the results of the gamma spectroscopic and strontium-90 analyses of the shoreline soil samples. Naturally occurring radionuclides were detected in the shoreline soil samples. There were no plant related nuclides detected in the 2021 samples.

An historical look at Cs-137 detected in shoreline soil at indicator and control locations can be viewed in Table C-5 and Figure C-5. Cesium-137 has been present in this media, both at indicator and occasionally at the control location, at a consistent level over the past ten years. Cesium-134 and Cs-137 are both discharged from the plant in similar quantities. The lack of Cs-134 activity is an indication that the primary source of the Cs-137 in the shoreline soil is legacy contamination from weapons fallout.

Strontium-90 (Sr-90) was not detected in any of the six indicator location samples or any of the control location samples.

4.9 Hudson River Aquatic Vegetation

Table B-15 results show no plant related radionuclides were detected in any indicator or control aquatic vegetation samples in 2021. This is consistent with historical findings.

4.10 Fish and Invertebrates

Table B-16 contains the results of the analysis of fish and invertebrate samples for 2021. No plant related radionuclides were detected. This is consistent with historical results which are shown in Table and Figure C-7.

4.11 Land Use Census

A census was performed in the vicinity of Indian Point in 2021. This census consisted of a milch animal and a residence census. Results of this census are presented in Tables B-17 and B-18.

The results of the 2021 census were generally same as the 2020 census results. In 2020 the presence of goats was noted on a property located less than 5.0 miles of IPEC, discussions with the owner of the property indicated that the goats did not produce milk for human consumption. Similar to 2020, it was noted in 2021 that no animals were producing milk for human consumption at this location or any other location within 5 miles to IPEC.

However, discussions with the owner for the 2021 land use surveys confirmed that the goats did not produce milk for human consumption and are therefore not milch animals.

The 2021 land use census indicated there were no new residences that were closer in proximity to IPEC.

The ODCM allows the sampling of broad leaf vegetation in two sectors at the site boundary in lieu of performing a garden census. Analysis results for these two sectors are discussed in Section 4.5 and presented in Table B-11, Table C-6 and Figure C-6.

4.12 Conclusion

The Radiological Environmental Monitoring Program is conducted each year to determine the radiological impact of Indian Point operations on the environment. The preceding discussions of the results of the 2021 REMP reveal that operations at the station did not result in an impact on the environment.

The 2021 REMP results demonstrate the relative contributions of different radionuclide sources, both natural and anthropogenic, to the environmental concentrations. The results indicate that the fallout from previous atmospheric weapons testing continues to contribute to detection of Cs-137 in some environmental samples. There are infrequent detections of plant related activity in the environs; however, the radiological levels are very low and are significantly less than those from natural background and other anthropogenic sources.

SECTION 5.0

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

5.1 2021 Annual Radiological Environmental Monitoring Program Summary

The results of the 2021 radiological environmental sampling program are presented in Tables B-2 through B-16. Table B-2 is a summary table of the sample results for 2021. The format of this summary table conforms to the reporting requirements of the ODCM, NRC Regulatory Guide 4.8, and NRC Branch Technical Position to Regulatory Guide 4.8 (Reference 4). In addition, the data obtained from the analysis of samples are provided in Tables B-3 through B-16.

REMP samples were analyzed by various counting methods as appropriate. The methods are; gross beta, gamma spectroscopy analysis, liquid scintillation, radiochemical analysis, and TLD processing. Gamma spectroscopy analysis was performed for gamma emitting nuclides, including the following: Be-7, K-40, Mn-54, Co-58, Co-60, Fe-59, Zn-65, Zr-95, Nb-95, Ru-103, Ru-106, I-131, Cs-134, Cs-137, Ba/La-140, Ce-141, Ce-144, Ra-226 and Ac/Th-228. Radiochemical analyses were performed for H-3, Ni-63, Sr-90 and I-131 for specific media and locations as required in the ODCM.

5.2 Land Use Census

In accordance with Sections IP2-D3.5.2 and IP3-2.8 of the ODCM, a land use census was conducted to identify the nearest milch animal and the nearest residence. The results of the milch animal and land use census are presented in Tables B-17 and B-18, respectively. In lieu of identifying and sampling the nearest garden of greater than 50 m^2, at least three kinds of broad leaf vegetation were sampled near the site boundary in two sectors and at a designated control location (results are presented in Table B-11).

5.3 Sampling Deviations

During 2021, environmental sampling was performed for 10 unique media types addressed in the ODCM and for direct radiation. A total of 1172 samples of 1177 scheduled were obtained. Of the scheduled samples, 99.6% were collected and analyzed for the program. Sampling deviations are summarized in Table B-1. Discussions of the reasons for the deviations are provided in Table B-1a for the air samples, Table B-1b for other media, and Table B-1c for changes to the REMP program. Analytical deviations noted in Table B-6 and B-7 due to insufficient sample volumes as noted in Table B-1a.

5.4 Analytical Deviations

No analytical deviations were found in 2021.

5.5 Special Reports

No special reports were required under the REMP.

TABLE B-1

Summary of Sampling Deviations - 2021

MEDIA	TOTAL SCHEDULED SAMPLES	NUMBER OF DEVIATIONS*	SAMPLING EFFICIENCY %	NUMBER OF ANALYSES**	REASON FOR DEVIATION
MEDIA					
TLD	164	0	100%	164	N/A
PARTICULATES IN AIR	424	0	100%	456	N/A
CHARCOAL FILTER	424	0	100%	424	N/A
DRINKING WATER	24	0	100%	56	N/A
SOIL	3	0	100%	3	N/A
BROAD LEAF VEGETATION	54	0	100%	54	N/A
HUDSON RIVER WATER	24	0	100%	32	N/A
SHORELINE SOIL	10	0	100%	20	N/A
HUDSON RIVER BOTTOM SEDIMENT	8	0	100%	8	N/A
AQUATIC VEGETATION	6	2	67%	4	See Table B-1b
FISH & INVERTEBRATES	36	3	94%	98	See Table B-1b
TOTALS	1177	5	99.6%	1319	

TOTAL NUMBER OF SAMPLES COLLECTED = 1172

* Samples not collected or unable to be analyzed.

** Several sample types require more than one analysis

TABLE B-1a

2021 Air Sampling Deviations

LOCATION	DATE	PROBLEM / ACTIONS TO PREVENT RECURRENCE
04 Algonquin	2/4/2021	Air sampler collection frequency exceeded 7 days + 25%. CPR-IP3-2021-00333. Cb.
05 NYC Tower	2/4/2021	Air sampler collection frequency exceeded 7 days + 25%. CPR-IP3-2021-00333. Cb.
29 Grassy Point	2/4/2021	Air sampler collection frequency exceeded 7 days + 25%. CPR-IP3-2021-00333. Cb.
108 Telecomm	2/4/2021	Air sampler collection frequency exceeded 7 days + 25%. CPR-IP3-2021-00333. Cb.
27 Croton Point	10/4/2021	Air sampler lost 22 hours of run time due to hour meter repair. IR-IP3-2021-00229.

TABLE B-1b

2021 Other Media Deviations

LOCATION	DATE	PROBLEM / ACTIONS TO PREVENT RECURRENCE
38 Furnace Dock	1/7/2021	During collection of 1st Quarter REMP TLDs it was discovered that the TLD was missing from the Cortlandt Yacht Club location. CR-IP2-2021-00017.
10 Hudson River Discharge	2/4/2021	Sample was not able to be obtained due to pump failure. Grab sample was collected. CR-IP2-2021-00058.
23 Roseton Hudson River	5/3/2021	Sample was not able to be obtained due to the pump being in pause mode. Grab sample was collected. CR-IP2-2021-00237.
17 Verplanck	Spring	Aquatic Vegetation samples were not available in the riverbed areas designated for these samples during the Spring sampling event.
25 Indian Point	Spring	Crab samples were not available during the Spring sampling event.
23 Poughkeepsie	Spring	Crab samples were not available during the Spring sampling event.
17 Verplanck	Summer	Aquatic Vegetation samples were not available in the riverbed areas designated for these samples during the Summer sampling event.
107 Croton - Haverstraw	Summer	Striped Bass samples were not available during the Spring sampling event
25 Downstream	9/15/21	Stripped Bass samples had limited amount of sample. Strontium-90 was unable to be performed.

TABLE B-1c

2021 Changes to the REMP Program

LOCATION	DATE	Discussion of REMP Change
No changes to the REMP program in 2021.		

TABLE B-2 RADIOLOGICIAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2021
Dockets 50-003, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine
				Mean ** (Range)	Location Number	Distance Direction	Mean** (Range)	Mean** (Range)	Reported Measurements
Direct Radiation (mR/Standard Quarter)	TLD-Quarterly	164		13.2 (160/160) (9.4/16.6)	DR-13	1.21 Mi. W	15.5 (4/4) (14.8/16.6)	14.1 (4/4) (13.1/15.6)	0
Air Particulate (pCi/m^3)	Gr-B	424	0.01	.014 (371/371) (.005/.026)	4	0.28 Mi. SW	.015 (53/53) (.006/.026)	.014 (53/53) (.005/.023)	0
Air Iodine (pCi/m^3)	GAMMA I-131	424	0.07	<LLD			-	<LLD	0
Air Particulate (10^{-3} pCi/m^3)	GAMMA Be-7	32	NA	112.9 (28/28) (84.5/151.6)	94	0.39 Mi. S	117.1 (4/4) (99.7/131.1)	95.0 (4/4) (77.8/124.2)	0
	K-40		NA	<LLD			-	<LLD	0
	Cs-134		0.05	<LLD			-	<LLD	0
	Cs-137		0.06	<LLD			-	<LLD	0
	Th-228		NA	<LLD			-	<LLD	0
Drinking Water (pCi/L)	Gr-B	24	4	3.16 (9/24) (2.49/5.38)	8	6.3 Mi. SE	3.47 (5/12) (2.54/5.38)	NA	0
	H-3	8	200	<LLD			-	NA	0
	GAMMA Mn-54	24	15	<LLD			-	NA	0
	Co-58		15	<LLD			-	NA	0
	Fe-59		30	<LLD			-	NA	0
	Co-60		15	<LLD			-	NA	0
	Zn-65		30	<LLD			-	NA	0
	Nb-95		15	<LLD			-	NA	0
	Zr-95		30	<LLD			-	NA	0
	I-131		15	<LLD			-	NA	0
	Cs-134		15	<LLD			-	NA	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2021
Dockets 50-003, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine
				Mean ** (Range)	Location Number	Distance Direction	Mean** (Range)	Mean** (Range)	Reported Measurements
Drinking Water (cont'd) (pCi/L)	Cs-137		18	<LLD			-	NA	0
	Ba-140		60	<LLD			-	NA	0
	La-140		15	<LLD			-	NA	0
Soil (pCi/kg dry)	GAMMA Be-7	3	NA	<LLD			-	<LLD	0
	K-40		NA	10320 (2/2) (8669/11970)	23	20.7 Mi. N	14750 (1/1)	14750 (1/1)	0
	Co-60		NA	<LLD			-	<LLD	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	<LLD			-	<LLD	0
	Ra-226		NA	<LLD			-	<LLD	0
	Th-228		NA	589 (1/2)	23	20.7 Mi. N	715 (1/1)	715 (1/1)	0
Broad leaf Vegetation (pCi/kg wet)	GAMMA Be-7	54	NA	2133 (36/36) (758.2/5935)	23	20.7 Mi. N	2486 (17/18) (1009/5319)	2486 (17/18) (1009/5319)	0
	K-40		NA	4814 (36/36) (2224/10050)	95	0.46 Mi. SSW	5638 (18/18) (3285/10050)	4637 (18/18) (2381/7444)	0
	Co-60		NA	<LLD			-	<LLD	0
	I-131		60	<LLD			-	<LLD	0
	Cs-134		60	<LLD			-	<LLD	0
	Cs-137		80	<LLD			-	<LLD	0
	Th-228		NA	127 (3/36) (98.5/169.4)	95	0.46 Mi. SSW	141.8 (2/18) (114.2/169.4)	<LLD	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2021
Dockets 50-003, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine
				Mean ** (Range)	Location Number	Distance Direction	Mean** (Range)	Mean** (Range)	Reported Measurements
River Water (pCi/L)	H-3	8	200	380.0 (3/4) (214/483)	10	0.3 Mi. WSW	380.0 (3/4) (214/483)	<LLD	0
	GAMMA	24							
	Mn-54		15	<LLD			-	<LLD	0
	Co-58		15	<LLD			-	<LLD	0
	Fe-59		30	<LLD			-	<LLD	0
	Co-60		15	<LLD			-	<LLD	0
	Zn-65		30	<LLD			-	<LLD	0
	Nb-95		15	<LLD			-	<LLD	0
	Zr-95		30	<LLD			-	<LLD	0
	Cs-134		15	<LLD			-	<LLD	0
	I-131		15	<LLD			-	<LLD	0
	Cs-137		18	<LLD			-	<LLD	0
	Ba-140		60	<LLD			-	<LLD	0
	La-140		15	<LLD			-	<LLD	0
	Th-228		NA	9.974 (1/12)	10	0.3 Mi. WSW	9.974 (1/12)	<LLD	0
Bottom Sediment (pCi/kg dry)	GAMMA	8							
	K-40		NA	16472 (6/6) (13790/21400)	84	10.88 Mi. N	19885 (2/2) (19560/20210)	19885 (2/2) (19560/20210)	0
	Co-60		NA	<LLD			-	<LLD	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	182.5 (5/6) (94.4/321.4)	84	10.88 Mi. N	256.9 (1/2)	256.9 (1/2)	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2021
Dockets 50-003, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine
				Mean ** (Range)	Location Number	Distance Direction	Mean** (Range)	Mean** (Range)	Reported Measurements
Bottom Sediment (cont'd) (pCi/kg dry)	Ra-226		NA	2270 (2/6) (1962/2578)	17	1.5 Mi. SSW	2270 (2/2) (1962/2578)	<LLD	0
	Th-228		NA	718.6 (6/6) (244/900)	84	10.88 Mi. N	1027.4 (2/2) (970/1085)	1027.4 (2/2) (970/1085)	0
Shoreline Soil (pCi/kg dry)	Sr-90	10	50	<LLD			-	<LLD	0
	GAMMA K-40	10	NA	11083 (6/6) (8047/13410)	84	10.88 Mi. N	31200 (2/2) (30250/32150)	21160 (4/4) (9070/32150)	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	<LLD			-	<LLD	0
	Ra-226		NA	<LLD	50	4.48 Mi. NNW	2435 (1/4)	2435 (1/4)	0
	Ac-228		NA	<LLD			-	<LLD	0
	Th-228		NA	368.0 (4/6) (203/493)	50	4.48 Mi. NNW	613.7 (2/2) (577/650)	512.0 (4/4) (335/650)	0
Aquatic Vegetation (pCi/kg wet)	GAMMA Be-7	4	NA	385.5 (1/2)	28	0.45 Mi. ENE	385.5 (1/2)	<LLD	0
	K-40		NA	2173 (2/2) (2134/2212)	84	10.88 Mi. N	2688 (2/2) (2405/2971)	2688 (2/2) (2405/2971)	0
	Co-60		NA	<LLD			-	<LLD	0
	I-131		60	<LLD			-	<LLD	0
	Cs-134		60	<LLD			-	<LLD	0
	Cs-137		80	<LLD			-	<LLD	0
	Ra-226		NA	<LLD			-	<LLD	0
	Ac-228		NA	<LLD			-	<LLD	0
	Th-228		NA	<LLD			-	<LLD	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2021
Dockets 50-003, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine
				Mean ** (Range)	Location Number	Distance Direction	Mean** (Range)	Mean** (Range)	Reported Measurements
Fish (pCi/kg wet)	Ni-63	33	100	<LLD			-	<LLD	0
	Sr-90	32	5	<LLD			-	<LLD	0
	GAMMA K-40	33	NA	2422 (22/22) (1185/3573)	23	20.7 Mi. N	2780 (11/11) (1827/4154)	2780 (11/11) (1827/4154)	0
	Mn-54		130	<LLD			-	<LLD	0
	Co-58		130	<LLD			-	<LLD	0
	Fe-59		260	<LLD			-	<LLD	0
	Co-60		130	<LLD			-	<LLD	0
	Zn-65		260	<LLD			-	<LLD	0
	Cs-134		130	<LLD			-	<LLD	0
	Cs-137		150	<LLD			-	<LLD	0
	Th-228		NA	212.1 (1/22)	25	Downstream	212.1 (1/22)	<LLD	0
Environment	Samples	1172							
	Analysis	1319							

* LLD IS THE LOWER LIMIT OF DETECTION
** THE MEAN VALUES ARE CALCULATED USING THE POSITIVE VALUES

INDIAN POINT ENERGY CENTER

TABLE B-3

DIRECT RADIATION, QUARTERLY DATA - 2021

mR/Quarter ± 1 sigma

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Annual Average	Annual Total
TLD	DR-01	14.1 ± 0.5	15.8 ± 0.6	15.7 ± 1.0	15.0 ± 1.1	15.1 ± 0.8	60.6
	DR-02	13.5 ± 0.6	14.6 ± 0.6	14.9 ± 1.0	14.3 ± 0.6	14.3 ± 0.6	57.3
	DR-03	11.8 ± 0.8	12.8 ± 0.5	12.6 ± 0.9	12.2 ± 0.7	12.4 ± 0.4	49.4
	DR-04	12.1 ± 0.6	14.0 ± 0.5	13.6 ± 0.9	12.9 ± 0.6	13.2 ± 0.8	52.6
	DR-05	12.2 ± 0.5	13.9 ± 0.7	13.7 ± 0.8	12.6 ± 0.6	13.1 ± 0.8	52.3
	DR-06	12.9 ± 0.8	14.0 ± 0.7	13.8 ± 0.9	13.7 ± 0.6	13.6 ± 0.5	54.4
	DR-07	13.7 ± 0.5	15.7 ± 0.5	15.6 ± 1.1	14.4 ± 0.7	14.8 ± 0.9	59.3
	DR-08	10.9 ± 0.6	11.9 ± 0.4	12.3 ± 0.8	11.6 ± 0.5	11.7 ± 0.6	46.6
	DR-09	12.2 ± 0.6	13.3 ± 0.6	12.8 ± 0.8	12.7 ± 0.7	12.7 ± 0.5	50.9
	DR-10	11.4 ± 0.6	12.5 ± 0.5	13.5 ± 1.0	12.7 ± 0.6	12.5 ± 0.8	50.1
	DR-11	9.9 ± 0.5	11.2 ± 0.4	9.4 ± 0.7	9.9 ± 0.5	10.1 ± 0.8	40.4
	DR-12	14.0 ± 0.8	16.2 ± 0.7	14.7 ± 0.9	14.5 ± 0.6	14.8 ± 0.9	59.3
	DR-13	14.8 ± 0.9	16.6 ± 0.6	15.4 ± 1.0	15.2 ± 0.7	15.5 ± 0.8	62.0
	DR-14	11.7 ± 0.8	13.3 ± 0.5	12.3 ± 0.8	12.3 ± 0.7	12.4 ± 0.7	49.5
	DR-15	11.4 ± 0.7	13.2 ± 0.5	12.0 ± 0.8	12.3 ± 0.5	12.2 ± 0.7	49.0
	DR-16	12.5 ± 0.6	14.9 ± 0.6	13.2 ± 0.9	13.7 ± 0.6	13.6 ± 1.0	54.3
	DR-17	12.4 ± 0.5	14.0 ± 0.7	13.7 ± 0.9	13.5 ± 0.7	13.4 ± 0.7	53.5
	DR-18	12.4 ± 0.7	14.4 ± 0.6	13.3 ± 0.8	13.7 ± 0.6	13.4 ± 0.8	53.8
	DR-19	12.7 ± 0.6	14.7 ± 0.5	13.7 ± 0.9	13.2 ± 0.6	13.6 ± 0.8	54.3
	DR-20	12.2 ± 0.5	14.0 ± 0.7	13.3 ± 0.8	13.3 ± 0.6	13.2 ± 0.8	52.8
	DR-21	12.6 ± 0.7	14.2 ± 0.5	13.2 ± 0.9	13.4 ± 0.6	13.3 ± 0.6	53.4
	DR-22	10.0 ± 0.4	11.7 ± 0.4	10.4 ± 0.7	10.5 ± 0.5	10.6 ± 0.7	42.5
	DR-23	12.6 ± 0.6	13.8 ± 0.5	12.4 ± 0.8	13.4 ± 0.7	13.1 ± 0.6	52.3
	DR-24	12.8 ± 0.6	14.3 ± 0.9	14.1 ± 0.7	13.7 ± 0.7	13.7 ± 0.6	54.9
	DR-25	10.8 ± 0.5	12.0 ± 0.8	12.1 ± 0.7	11.2 ± 0.6	11.5 ± 0.6	46.1
	DR-26	12.4 ± 0.4	13.6 ± 0.5	12.7 ± 0.7	12.6 ± 0.5	12.8 ± 0.5	51.2
	DR-27	12.0 ± 0.7	13.6 ± 0.8	13.0 ± 0.6	12.6 ± 0.6	12.8 ± 0.7	51.3
	DR-28	13.7 ± 0.6	15.3 ± 0.5	14.6 ± 0.5	14.2 ± 0.7	14.4 ± 0.7	57.8
	DR-29	12.1 ± 0.5	13.8 ± 0.6	13.6 ± 0.7	13.1 ± 0.7	13.2 ± 0.8	52.6
	DR-30	12.3 ± 0.5	13.9 ± 0.9	13.7 ± 0.7	13.1 ± 0.8	13.3 ± 0.7	53.1
	DR-31	14.4 ± 0.7	15.9 ± 0.7	15.4 ± 0.9	15.0 ± 0.6	15.2 ± 0.7	60.7
	DR-32	13.6 ± 0.5	15.3 ± 0.8	15.5 ± 0.9	14.7 ± 0.7	14.8 ± 0.9	59.1
	DR-33	12.1 ± 0.7	13.1 ± 0.6	13.0 ± 0.7	12.6 ± 0.7	12.7 ± 0.4	50.7
	DR-34	11.6 ± 0.4	13.0 ± 0.5	12.6 ± 0.6	12.4 ± 0.6	12.4 ± 0.6	49.5
	DR-35	11.9 ± 0.5	14.1 ± 0.7	14.2 ± 0.5	15.0 ± 0.7	13.8 ± 1.3	55.2
	DR-36	13.5 ± 0.6	14.5 ± 0.6	14.1 ± 0.6	13.8 ± 0.7	14.0 ± 0.4	55.8
	DR-37	12.1 ± 0.5	13.4 ± 0.6	13.1 ± 0.5	12.2 ± 0.6	12.7 ± 0.6	50.8
	DR-38	11.2 ± 0.5	12.1 ± 0.6	11.8 ± 0.6	11.3 ± 0.7	11.6 ± 0.4	46.4
	DR-39	13.1 ± 0.4	14.5 ± 0.7	14.3 ± 0.6	13.9 ± 0.6	13.9 ± 0.6	55.8
	DR-40*	13.1 ± 0.5	13.7 ± 0.4	15.6 ± 0.7	13.9 ± 0.7	14.1 ± 1.0	56.3
	DR-41	11.5 ± 0.6	13.4 ± 0.8	12.6 ± 0.5	11.6 ± 0.6	12.3 ± 0.9	49.1
AVERAGE (Indicator Locations)		12.4 ± 1.1	13.9 ± 1.2	13.4 ± 1.3	13.1 ± 1.2	13.2 ± 1.2	52.8

* Control location

INDIAN POINT ENERGY CENTER

TABLE B-4

DIRECT RADIATION, 2012 THROUGH 2021 DATA

mR per Year

Station Number	Mean (2012-2020)	Standard Deviation (2012-2020)	Minimum Value (2012-2020)	Maximum Value (2012-2020)	2021 Annual Total
DR-01	62.0	3.0	55.6	65.6	60.6
DR-02	58.3	1.7	55.9	60.4	57.3
DR-03	46.9	5.0	35.0	50.9	49.4
DR-04	53.3	1.0	52.1	54.8	52.6
DR-05	54.9	1.6	53.3	58.2	52.3
DR-06	56.2	1.4	54.7	58.0	54.4
DR-07	62.6	1.4	60.7	64.6	59.3
DR-08	47.4	1.6	45.1	49.5	46.6
DR-09	53.4	2.1	50.0	55.8	50.9
DR-10	56.9	4.7	53.0	67.7	50.1
DR-11	43.2	1.1	41.4	44.6	40.4
DR-12	60.6	4.5	49.2	64.8	59.3
DR-13	64.7	1.9	62.3	67.6	62.0
DR-14	52.3	1.2	50.5	54.0	49.5
DR-15	52.2	1.3	50.3	53.8	49.0
DR-16	57.6	1.6	55.1	59.3	54.3
DR-17	57.8	1.7	55.6	60.1	53.5
DR-18	56.4	1.3	54.4	58.2	53.8
DR-19	58.3	1.5	55.9	60.4	54.3
DR-20	55.5	1.3	53.4	57.5	52.8
DR-21	55.2	2.5	51.9	58.4	53.4
DR-22	45.1	1.7	42.6	47.7	42.5
DR-23	55.6	1.4	53.6	57.4	52.3
DR-24	58.2	1.6	55.8	60.2	54.9
DR-25	48.3	1.3	45.7	50.0	46.1
DR-26	55.0	1.2	53.0	56.5	51.2
DR-27	54.0	1.6	51.5	56.5	51.3
DR-28	69.5	11.3	51.3	80.6	57.8
DR-29	56.3	1.2	54.8	58.3	52.6
DR-30	57.0	1.4	54.7	59.3	53.1
DR-31	64.7	1.9	61.5	67.4	60.7
DR-32	54.9	5.2	48.7	63.3	59.1
DR-33	53.7	1.1	52.3	55.6	50.7
DR-34	52.6	1.8	50.2	55.0	49.5
DR-35	52.9	2.6	49.9	56.3	55.2
DR-36	57.6	1.3	55.9	59.6	55.8
DR-37	54.8	1.2	53.3	56.8	50.8
DR-38	47.5	3.7	38.5	50.9	46.4
DR-39	57.8	1.8	54.8	59.4	55.8
DR-40*	58.7	4.2	49.3	62.4	56.3
DR-41	52.0	1.7	49.7	53.9	49.1
AVERAGE (Indicator Locations)	55.3				52.8

* Control location

INDIAN POINT ENERGY CENTER

TABLE B-5

DIRECT RADIATION, INNER AND OUTER RINGS - 2021

(mR per Year)

Inner Ring ID	Outer Ring ID	Sector	Inner Ring Annual Total	Outer Ring Annual Total
DR-01	DR-17	N	60.57	53.54
DR-02	DR-18	NNE	57.26	53.78
DR-03	DR-19	NE	49.43	54.29
DR-04	DR-20	ENE	52.62	52.78
DR-05	DR-21	E	52.29	53.38
DR-06	DR-22	ESE	54.37	42.50
DR-07	DR-23	SE	59.32	52.25
DR-08	DR-24	SSE	46.63	54.93
DR-09	DR-25	S	50.91	46.10
DR-10	DR-26	SSW	50.08	51.21
DR-11	DR-27	SW	40.36	51.27
DR-12	DR-28	WSW	59.33	57.79
DR-13	DR-29	W	61.95	52.63
DR-14	DR-30	WNW	49.54	53.06
DR-15	DR-31	NW	48.95	60.71
DR-16	DR-32	NNW	54.33	59.07
		Average	53.00	53.08

INDIAN POINT ENERGY CENTER

TABLE B-6

GROSS BETA ACTIVITY IN AIRBORNE PARTICULATE SAMPLES - 2021

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Training Building 94	Met Tower 95	Telcom Bldg. 108
01/05/21	0.009 ± 0.002	0.008 ± 0.002	0.008 ± 0.002	0.012 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.002
01/11/21	0.009 ± 0.002	0.006 ± 0.002	0.008 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.007 ± 0.002	0.008 ± 0.002	0.010 ± 0.002
01/19/21	0.026 ± 0.003	0.025 ± 0.003	0.019 ± 0.002	0.018 ± 0.003	0.022 ± 0.003	0.021 ± 0.003	0.023 ± 0.003	0.022 ± 0.003
01/25/21	0.011 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.003	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.011 ± 0.002
02/04/21	0.006 ± 0.001	0.008 ± 0.002	0.007 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.007 ± 0.001
02/08/21	0.021 ± 0.004	0.018 ± 0.004	0.016 ± 0.003	0.013 ± 0.003	0.020 ± 0.004	0.014 ± 0.003	0.015 ± 0.003	0.020 ± 0.004
02/16/21	0.019 ± 0.003	0.021 ± 0.003	0.017 ± 0.002	0.021 ± 0.003	0.018 ± 0.002	0.020 ± 0.003	0.016 ± 0.002	0.020 ± 0.002
02/22/21	0.016 ± 0.003	0.016 ± 0.003	0.015 ± 0.003	0.014 ± 0.003	0.014 ± 0.003	0.017 ± 0.003	0.013 ± 0.003	0.014 ± 0.003
03/01/21	0.013 ± 0.003	0.014 ± 0.003	0.012 ± 0.002	0.012 ± 0.002	0.014 ± 0.002	0.011 ± 0.002	0.012 ± 0.002	0.014 ± 0.002
03/08/21	0.013 ± 0.002	0.015 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.011 ± 0.002	0.012 ± 0.002
03/15/21	0.022 ± 0.003	0.021 ± 0.003	0.023 ± 0.003	0.021 ± 0.003	0.023 ± 0.003	0.019 ± 0.003	0.020 ± 0.003	0.022 ± 0.003
03/22/21	0.018 ± 0.003	0.019 ± 0.003	0.016 ± 0.002	0.016 ± 0.002	0.018 ± 0.003	0.020 ± 0.003	0.018 ± 0.003	0.019 ± 0.003
03/29/21	0.013 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.013 ± 0.002	0.009 ± 0.002	0.011 ± 0.002
04/05/21	0.017 ± 0.003	0.015 ± 0.003	0.015 ± 0.003	0.016 ± 0.003	0.014 ± 0.003	0.016 ± 0.003	0.014 ± 0.002	0.016 ± 0.003
04/12/21	0.010 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.010 ± 0.002
04/19/21	0.006 ± 0.002	0.006 ± 0.002	0.007 ± 0.002	0.006 ± 0.002	0.006 ± 0.002	0.006 ± 0.002	0.005 ± 0.002	0.006 ± 0.002
04/27/21	0.020 ± 0.003	0.015 ± 0.002	0.016 ± 0.003	0.018 ± 0.003	0.018 ± 0.003	0.018 ± 0.002	0.017 ± 0.003	0.018 ± 0.003
05/03/21	0.016 ± 0.003	0.015 ± 0.003	0.015 ± 0.003	0.019 ± 0.003	0.017 ± 0.003	0.017 ± 0.003	0.018 ± 0.003	0.020 ± 0.003
05/10/21	0.009 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.008 ± 0.002	0.010 ± 0.002
05/17/21	0.011 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.012 ± 0.002
05/24/21	0.020 ± 0.003	0.017 ± 0.003	0.017 ± 0.003	0.017 ± 0.003	0.017 ± 0.003	0.018 ± 0.003	0.018 ± 0.003	0.018 ± 0.003
06/01/21	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.011 ± 0.002	0.010 ± 0.002
06/07/21	0.015 ± 0.003	0.015 ± 0.003	0.017 ± 0.003	0.015 ± 0.003	0.022 ± 0.003	0.019 ± 0.003	0.019 ± 0.003	0.019 ± 0.003
06/14/21	0.010 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002
06/21/21	0.012 ± 0.002	0.016 ± 0.002	0.014 ± 0.002	0.017 ± 0.003	0.015 ± 0.002	0.014 ± 0.003	0.013 ± 0.002	0.015 ± 0.003
06/28/21	0.009 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.009 ± 0.002

*Control Location

INDIAN POINT ENERGY CENTER

TABLE B-6

GROSS BETA ACTIVITY IN AIRBORNE PARTICULATE SAMPLES - 2021

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Training Building 94	Met Tower 95	Telcom Bldg. 108
07/06/21	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.012 ± 0.002	0.010 ± 0.002	0.010 ± 0.002
07/12/21	0.014 ± 0.003	0.013 ± 0.003	0.014 ± 0.003	0.016 ± 0.003	0.016 ± 0.003	0.015 ± 0.003	0.016 ± 0.003	0.014 ± 0.003
07/19/21	0.014 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.014 ± 0.003	0.012 ± 0.002
07/26/21	0.016 ± 0.002	0.015 ± 0.002	0.013 ± 0.002	0.017 ± 0.003	0.016 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.015 ± 0.002
08/02/21	0.014 ± 0.003	0.015 ± 0.003	0.015 ± 0.003	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.013 ± 0.002	0.014 ± 0.002
08/09/21	0.018 ± 0.003	0.019 ± 0.003	0.021 ± 0.003	0.019 ± 0.003	0.016 ± 0.002	0.017 ± 0.003	0.017 ± 0.003	0.019 ± 0.003
08/16/21	0.016 ± 0.002	0.011 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.013 ± 0.002	0.013 ± 0.002
08/23/21	0.011 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.013 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.012 ± 0.002	0.011 ± 0.002
08/30/21	0.020 ± 0.003	0.019 ± 0.003	0.021 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.019 ± 0.003	0.020 ± 0.003
09/07/21	0.010 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
09/13/21	0.017 ± 0.003	0.017 ± 0.003	0.018 ± 0.003	0.017 ± 0.003	0.019 ± 0.003	0.019 ± 0.003	0.017 ± 0.003	0.017 ± 0.003
09/20/21	0.021 ± 0.003	0.021 ± 0.003	0.021 ± 0.003	0.020 ± 0.003	0.023 ± 0.003	0.019 ± 0.003	0.019 ± 0.003	0.021 ± 0.003
09/27/21	0.010 ± 0.002	0.010 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.011 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.012 ± 0.002
10/04/21	0.015 ± 0.002	0.017 ± 0.003	0.015 ± 0.002	0.017 ± 0.003	0.016 ± 0.003	0.017 ± 0.003	0.014 ± 0.002	0.016 ± 0.002
10/12/21	0.007 ± 0.002	0.007 ± 0.002	0.005 ± 0.002	0.008 ± 0.002	0.008 ± 0.003	0.005 ± 0.002	0.006 ± 0.002	0.008 ± 0.002
10/18/21	0.016 ± 0.002	0.016 ± 0.003	0.015 ± 0.002	0.017 ± 0.003	0.016 ± 0.003	0.014 ± 0.002	0.013 ± 0.002	0.016 ± 0.002
10/25/21	0.021 ± 0.003	0.020 ± 0.003	0.018 ± 0.003	0.019 ± 0.003	0.021 ± 0.003	0.021 ± 0.003	0.022 ± 0.003	0.021 ± 0.003
11/01/21	0.014 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.012 ± 0.002	0.014 ± 0.003	0.016 ± 0.003	0.014 ± 0.002	0.015 ± 0.002
11/08/21	0.014 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.014 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002
11/15/21	0.025 ± 0.003	0.021 ± 0.003	0.022 ± 0.003	0.024 ± 0.003	0.023 ± 0.003	0.018 ± 0.003	0.023 ± 0.003	0.023 ± 0.003
11/22/21	0.011 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.013 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.011 ± 0.002
11/29/21	0.011 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.010 ± 0.002	0.011 ± 0.002
12/06/21	0.020 ± 0.003	0.015 ± 0.002	0.017 ± 0.003	0.015 ± 0.002	0.016 ± 0.002	0.017 ± 0.003	0.018 ± 0.003	0.018 ± 0.003
12/13/21	0.018 ± 0.003	0.019 ± 0.003	0.016 ± 0.003	0.017 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.017 ± 0.003	0.019 ± 0.003
12/20/21	0.017 ± 0.003	0.015 ± 0.003	0.016 ± 0.003	0.017 ± 0.003	0.016 ± 0.003	0.016 ± 0.003	0.015 ± 0.002	0.016 ± 0.002
12/28/21	0.016 ± 0.002	0.016 ± 0.002	0.016 ± 0.002	0.017 ± 0.002	0.018 ± 0.002	0.016 ± 0.002	0.016 ± 0.002	0.017 ± 0.002
01/03/22	0.024 ± 0.003	0.016 ± 0.003	0.020 ± 0.003	0.018 ± 0.003	0.020 ± 0.003	0.019 ± 0.003	0.021 ± 0.003	0.020 ± 0.003

*Control Location

INDIAN POINT ENERGY CENTER

TABLE B-7

IODINE-131 ACTIVITY IN AIRBORNE CHARCOAL SAMPLES - 2021

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Training Building 94	Met Tower 95	Telcom Bldg. 108
01/05/21	< 0.038	< 0.040	< 0.035	< 0.039	< 0.036	< 0.037	< 0.042	< 0.040
01/11/21	< 0.034	< 0.035	< 0.018	< 0.035	< 0.022	< 0.033	< 0.024	< 0.025
01/19/21	< 0.015	< 0.016	< 0.016	< 0.015	< 0.017	< 0.015	< 0.018	< 0.018
01/25/21	< 0.023	< 0.024	< 0.021	< 0.023	< 0.022	< 0.021	< 0.024	< 0.021
02/04/21	< 0.028	< 0.028	< 0.019	< 0.038	< 0.015	< 0.036	< 0.024	< 0.014
02/08/21	< 0.030	< 0.030	< 0.030	< 0.021	< 0.042	< 0.020	< 0.033	< 0.043
02/16/21	< 0.031	< 0.031	< 0.029	< 0.031	< 0.031	< 0.029	< 0.032	< 0.030
02/22/21	< 0.020	< 0.018	< 0.008	< 0.020	< 0.019	< 0.018	< 0.020	< 0.019
03/01/21	< 0.025	< 0.024	< 0.015	< 0.023	< 0.019	< 0.024	< 0.020	< 0.019
03/08/21	< 0.021	< 0.022	< 0.027	< 0.021	< 0.027	< 0.021	< 0.029	< 0.027
03/15/21	< 0.026	< 0.026	< 0.024	< 0.027	< 0.025	< 0.025	< 0.026	< 0.025
03/22/21	< 0.019	< 0.020	< 0.021	< 0.020	< 0.022	< 0.008	< 0.022	< 0.021
03/29/21	< 0.016	< 0.017	< 0.016	< 0.017	< 0.016	< 0.015	< 0.015	< 0.016
04/05/21	< 0.037	< 0.038	< 0.049	< 0.037	< 0.051	< 0.039	< 0.049	< 0.052
04/12/21	< 0.022	< 0.023	< 0.019	< 0.022	< 0.019	< 0.021	< 0.018	< 0.019
04/19/21	< 0.018	< 0.018	< 0.018	< 0.018	< 0.019	< 0.008	< 0.017	< 0.018
04/27/21	< 0.016	< 0.016	< 0.017	< 0.016	< 0.016	< 0.015	< 0.014	< 0.017
05/03/21	< 0.029	< 0.029	< 0.019	< 0.029	< 0.018	< 0.028	< 0.022	< 0.020
05/10/21	< 0.021	< 0.022	< 0.021	< 0.021	< 0.010	< 0.021	< 0.022	< 0.020
05/17/21	< 0.036	< 0.036	< 0.022	< 0.036	< 0.021	< 0.034	< 0.023	< 0.021
05/24/21	< 0.015	< 0.016	< 0.014	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
06/01/21	< 0.022	< 0.024	< 0.032	< 0.025	< 0.035	< 0.024	< 0.036	< 0.034
06/07/21	< 0.023	< 0.011	< 0.031	< 0.026	< 0.030	< 0.026	< 0.026	< 0.030
06/14/21	< 0.027	< 0.025	< 0.017	< 0.027	< 0.017	< 0.027	< 0.017	< 0.018
06/21/21	< 0.029	< 0.028	< 0.024	< 0.029	< 0.024	< 0.029	< 0.024	< 0.026
06/28/21	< 0.020	< 0.020	< 0.030	< 0.020	< 0.030	< 0.021	< 0.031	< 0.030

*Control Location

INDIAN POINT ENERGY CENTER

TABLE B-7

IODINE-131 ACTIVITY IN AIRBORNE CHARCOAL SAMPLES - 2021

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Training Building 94	Met Tower 95	Telcom Bldg. 108
07/06/21	< 0.017	< 0.017	< 0.018	< 0.017	< 0.009	< 0.019	< 0.019	< 0.018
07/12/21	< 0.031	< 0.032	< 0.019	< 0.031	< 0.018	< 0.033	< 0.020	< 0.019
07/19/21	< 0.026	< 0.027	< 0.024	< 0.026	< 0.023	< 0.028	< 0.026	< 0.011
07/26/21	< 0.017	< 0.018	< 0.019	< 0.017	< 0.018	< 0.017	< 0.019	< 0.019
08/02/21	< 0.022	< 0.022	< 0.022	< 0.022	< 0.021	< 0.022	< 0.021	< 0.021
08/09/21	< 0.025	< 0.025	< 0.017	< 0.025	< 0.016	< 0.026	< 0.017	< 0.014
08/16/21	< 0.014	< 0.015	< 0.015	< 0.014	< 0.015	< 0.015	< 0.015	< 0.015
08/23/21	< 0.016	< 0.016	< 0.012	< 0.016	< 0.012	< 0.016	< 0.013	< 0.012
08/30/21	< 0.027	< 0.028	< 0.043	< 0.027	< 0.042	< 0.028	< 0.043	< 0.042
09/07/21	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017
09/13/21	< 0.014	< 0.014	< 0.028	< 0.014	< 0.027	< 0.014	< 0.027	< 0.026
09/20/21	< 0.021	< 0.022	< 0.021	< 0.021	< 0.020	< 0.021	< 0.021	< 0.020
09/27/21	< 0.033	< 0.034	< 0.019	< 0.033	< 0.019	< 0.034	< 0.019	< 0.015
10/04/21	< 0.030	< 0.032	< 0.026	< 0.029	< 0.027	< 0.030	< 0.026	< 0.011
10/12/21	< 0.022	< 0.019	< 0.039	< 0.022	< 0.039	< 0.022	< 0.009	< 0.037
10/18/21	< 0.028	< 0.031	< 0.027	< 0.031	< 0.028	< 0.029	< 0.027	< 0.027
10/25/21	< 0.026	< 0.026	< 0.019	< 0.025	< 0.019	< 0.026	< 0.018	< 0.018
11/01/21	< 0.019	< 0.019	< 0.015	< 0.019	< 0.016	< 0.020	< 0.015	< 0.010
11/08/21	< 0.064	< 0.064	< 0.018	< 0.063	< 0.019	< 0.065	< 0.018	< 0.008
11/15/21	< 0.024	< 0.024	< 0.021	< 0.023	< 0.022	< 0.025	< 0.020	< 0.009
11/22/21	< 0.017	< 0.017	< 0.020	< 0.016	< 0.020	< 0.018	< 0.020	< 0.020
11/29/21	< 0.025	< 0.025	< 0.018	< 0.025	< 0.018	< 0.025	< 0.018	< 0.018
12/06/21	< 0.021	< 0.021	< 0.021	< 0.021	< 0.021	< 0.023	< 0.021	< 0.021
12/13/21	< 0.014	< 0.014	< 0.013	< 0.013	< 0.013	< 0.015	< 0.013	< 0.013
12/20/21	< 0.018	< 0.018	< 0.017	< 0.018	< 0.018	< 0.019	< 0.017	< 0.017
12/28/21	< 0.019	< 0.019	< 0.017	< 0.019	< 0.017	< 0.021	< 0.017	< 0.016
01/03/22	< 0.047	< 0.048	< 0.029	< 0.046	< 0.029	< 0.046	< 0.031	< 0.024

*Control Location

INDIAN POINT ENERGY CENTER

TABLE B-8

GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2021

10^{-3} pCi/m^3 ± 2 Sigma

	Algonquin 4				NYU Tower 5			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	110 ± 21	133 ± 27	85 ± 28	85 ± 19	122 ± 23	121 ± 21	94 ± 19	91 ± 19
K-40	< 19	< 27	< 22	< 13	< 24	< 16	< 15	< 15
Mn-54	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Co-58	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Fe-59	< 5	< 7	< 6	< 6	< 4	< 4	< 5	< 4
Co-60	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1
Zn-65	< 2	< 3	< 4	< 3	< 4	< 2	< 3	< 3
Nb-95	< 2	< 3	< 3	< 2	< 2	< 1	< 2	< 1
Zr-95	< 3	< 4	< 5	< 3	< 4	< 4	< 4	< 3
Ru-103	< 2	< 3	< 4	< 2	< 3	< 2	< 3	< 2
Ru-106	< 9	< 16	< 11	< 9	< 13	< 9	< 9	< 9
I-131	< 118	< 222	< 410	< 386	< 184	< 149	< 302	< 405
Cs-134	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1
Cs-137	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1
Ba-140	< 71	< 138	< 147	< 152	< 113	< 61	< 131	< 109
La-140	< 2	< 65	< 54	< 70	< 33	< 18	< 50	< 39
Ce-141	< 4	< 5	< 6	< 4	< 5	< 3	< 4	< 4
Ce-144	< 5	< 7	< 6	< 5	< 7	< 4	< 5	< 4
Ra-226	< 17	< 22	< 20	< 15	< 22	< 15	< 17	< 14
Ac-228	< 4	< 6	< 5	< 4	< 4	< 4	< 4	< 4
Th-228	< 2	< 2	< 2	< 1	< 2	< 1	< 1	< 1

INDIAN POINT ENERGY CENTER

TABLE B-8

GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2021

10^{-3} pCi/m^3 ± 2 Sigma

	Roseton 23*				Croton Point 27			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	79 ± 24	124 ± 21	100 ± 23	78 ± 24	121 ± 20	137 ± 25	105 ± 22	101 ± 22
K-40	< 26	< 16	< 17	< 25	< 19	< 21	< 18	< 19
Mn-54	< 2	< 0	< 1	< 2	< 1	< 2	< 1	< 1
Co-58	< 2	< 1	< 2	< 3	< 2	< 2	< 2	< 2
Fe-59	< 7	< 3	< 6	< 8	< 5	< 6	< 5	< 5
Co-60	< 1	< 1	< 1	< 2	< 1	< 2	< 1	< 1
Zn-65	< 5	< 2	< 2	< 3	< 3	< 3	< 3	< 3
Nb-95	< 2	< 1	< 2	< 3	< 2	< 2	< 2	< 2
Zr-95	< 4	< 2	< 4	< 6	< 4	< 4	< 4	< 4
Ru-103	< 3	< 1	< 2	< 4	< 2	< 3	< 3	< 3
Ru-106	< 13	< 8	< 8	< 14	< 8	< 9	< 10	< 10
I-131	< 195	< 83	< 266	< 534	< 117	< 218	< 326	< 465
Cs-134	< 2	< 1	< 1	< 2	< 1	< 1	< 1	< 2
Cs-137	< 2	< 1	< 1	< 2	< 1	< 1	< 1	< 1
Ba-140	< 120	< 47	< 102	< 233	< 56	< 102	< 117	< 181
La-140	< 61	< 27	< 27	< 101	< 41	< 46	< 39	< 57
Ce-141	< 5	< 3	< 4	< 6	< 3	< 4	< 4	< 5
Ce-144	< 7	< 3	< 4	< 7	< 5	< 6	< 5	< 6
Ra-226	< 23	< 14	< 14	< 26	< 17	< 20	< 17	< 19
Ac-228	< 6	< 4	< 4	< 7	< 4	< 5	< 4	< 5
Th-228	< 2	< 1	< 1	< 2	< 1	< 2	< 1	< 2

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-8

GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2021

10^{-3} pCi/m^3 ± 2 Sigma

	Grassy Point 29				Training Building 94			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	117 ± 21	135 ± 23	120 ± 23	94 ± 22	131 ± 25	130 ± 22	100 ± 28	107 ± 23
K-40	< 22	< 21	< 24	< 26	< 30	< 13	< 27	< 26
Mn-54	< 1	< 1	< 1	< 2	< 2	< 1	< 2	< 2
Co-58	< 2	< 2	< 2	< 2	< 2	< 1	< 3	< 2
Fe-59	< 5	< 4	< 8	< 7	< 5	< 5	< 8	< 8
Co-60	< 2	< 1	< 1	< 1	< 1	< 1	< 2	< 1
Zn-65	< 3	< 2	< 3	< 3	< 4	< 2	< 4	< 4
Nb-95	< 2	< 2	< 2	< 3	< 3	< 1	< 3	< 3
Zr-95	< 4	< 3	< 4	< 4	< 5	< 3	< 4	< 5
Ru-103	< 2	< 3	< 4	< 3	< 4	< 2	< 5	< 5
Ru-106	< 12	< 11	< 14	< 12	< 11	< 8	< 17	< 13
I-131	< 120	< 147	< 378	< 686	< 200	< 138	< 491	< 626
Cs-134	< 1	< 1	< 1	< 1	< 2	< 1	< 2	< 2
Cs-137	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Ba-140	< 86	< 77	< 170	< 224	< 114	< 56	< 207	< 198
La-140	< 27	< 25	< 58	< 84	< 48	< 25	< 66	< 92
Ce-141	< 3	< 3	< 5	< 5	< 5	< 3	< 6	< 6
Ce-144	< 5	< 4	< 6	< 6	< 7	< 4	< 8	< 8
Ra-226	< 16	< 16	< 18	< 19	< 24	< 15	< 26	< 22
Ac-228	< 5	< 4	< 4	< 5	< 6	< 3	< 7	< 6
Th-228	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2

INDIAN POINT ENERGY CENTER

TABLE B-8

GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2021

10^{-3} pCi/m^3 ± 2 Sigma

	Met Tower 95				Telecomm Bldg 108			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	98 ± 20	152 ± 23	121 ± 19	92 ± 19	102 ± 20	124 ± 29	135 ± 23	101 ± 17
K-40	< 22	< 16	< 10	< 17	< 25	< 32	< 29	< 17
Mn-54	< 1	< 1	< 1	< 1	< 1	< 2	< 2	< 1
Co-58	< 2	< 2	< 1	< 2	< 2	< 3	< 3	< 1
Fe-59	< 5	< 6	< 5	< 5	< 6	< 4	< 10	< 6
Co-60	< 1	< 1	< 1	< 1	< 2	< 2	< 2	< 1
Zn-65	< 3	< 3	< 2	< 3	< 3	< 3	< 5	< 2
Nb-95	< 1	< 2	< 2	< 2	< 2	< 3	< 3	< 2
Zr-95	< 4	< 4	< 3	< 3	< 4	< 5	< 4	< 3
Ru-103	< 2	< 3	< 2	< 2	< 3	< 4	< 5	< 2
Ru-106	< 8	< 11	< 8	< 6	< 13	< 13	< 17	< 8
I-131	< 132	< 220	< 296	< 404	< 179	< 198	< 522	< 406
Cs-134	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1
Cs-137	< 1	< 1	< 1	< 1	< 2	< 1	< 2	< 1
Ba-140	< 67	< 100	< 101	< 146	< 98	< 96	< 203	< 128
La-140	< 33	< 52	< 44	< 40	< 29	< 49	< 85	< 45
Ce-141	< 3	< 5	< 4	< 4	< 4	< 6	< 7	< 4
Ce-144	< 4	< 5	< 4	< 4	< 6	< 7	< 7	< 4
Ra-226	< 14	< 21	< 13	< 13	< 21	< 24	< 26	< 16
Ac-228	< 4	< 4	< 2	< 4	< 5	< 5	< 7	< 3
Th-228	< 1	< 2	< 1	< 1	< 2	< 2	< 2	< 1

INDIAN POINT ENERGY CENTER

TABLE B-9

RADIONUCLIDES IN DRINKING WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Camp Field 7					
DATE	01/12/21	02/17/21	03/17/21	04/05/21	5/11/2021	06/07/21
RADIOCHEMICAL						
Gr-B	3 ± 1	< 3	< 2	< 2	< 3	< 2
H-3 (a)			< 177			< 184
GAMMA						
Be-7	< 54	< 42	< 60	< 56	< 52	< 49
K-40	< 145	< 75	< 68	< 119	< 110	< 110
Mn-54	< 9	< 4	< 8	< 6	< 6	< 5
Co-58	< 7	< 4	< 7	< 7	< 6	< 6
Fe-59	< 12	< 9	< 15	< 13	< 13	< 12
Co-60	< 7	< 4	< 6	< 9	< 7	< 6
Zn-65	< 14	< 8	< 11	< 14	< 11	< 14
Nb-95	< 8	< 4	< 7	< 6	< 5	< 4
Zr-95	< 13	< 6	< 13	< 15	< 10	< 9
Ru-103	< 7	< 5	< 7	< 7	< 5	< 6
Ru-106	< 59	< 42	< 56	< 48	< 64	< 52
I-131	< 9	< 7	< 9	< 7	< 6	< 8
Cs-134	< 7	< 6	< 9	< 9	< 8	< 7
Cs-137	< 8	< 5	< 7	< 7	< 6	< 6
Ba-140	< 27	< 26	< 32	< 29	< 22	< 20
La-140	< 8	< 9	< 9	< 9	< 11	< 9
Ce-141	< 13	< 7	< 11	< 11	< 11	< 9
Ce-144	< 53	< 30	< 43	< 46	< 43	< 43
Ra-226	< 166	< 110	< 162	< 153	< 182	< 153
Ac-228	< 27	< 17	< 25	< 27	< 30	< 19
Th-228	< 14	< 8	< 11	< 11	< 12	< 10

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-9

RADIONUCLIDES IN DRINKING WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Camp Field 7					
DATE	07/12/21	08/10/21	09/14/21	10/11/21	11/08/21	12/14/21
RADIOCHEMICAL						
Gr-B	2 ± 2	< 3	< 2	< 2	3 ± 2	3 ± 2
H-3 (a)			< 187			< 187
GAMMA						
Be-7	< 46	< 39	< 44	< 33	< 46	< 30
K-40	< 101	< 79	< 142	< 74	< 93	< 73
Mn-54	< 7	< 4	< 5	< 3	< 5	< 4
Co-58	< 7	< 3	< 5	< 4	< 4	< 4
Fe-59	< 12	< 8	< 13	< 8	< 10	< 7
Co-60	< 7	< 5	< 7	< 5	< 5	< 4
Zn-65	< 13	< 9	< 15	< 11	< 13	< 9
Nb-95	< 5	< 4	< 5	< 4	< 5	< 4
Zr-95	< 12	< 9	< 12	< 7	< 10	< 7
Ru-103	< 6	< 5	< 6	< 4	< 5	< 4
Ru-106	< 68	< 40	< 56	< 32	< 52	< 35
I-131	< 7	< 5	< 7	< 5	< 6	< 4
Cs-134	< 8	< 5	< 7	< 5	< 6	< 4
Cs-137	< 7	< 5	< 7	< 5	< 4	< 4
Ba-140	< 23	< 16	< 22	< 15	< 26	< 16
La-140	< 9	< 7	< 8	< 7	< 7	< 5
Ce-141	< 9	< 7	< 9	< 7	< 10	< 6
Ce-144	< 40	< 29	< 41	< 28	< 42	< 23
Ra-226	< 167	< 114	< 142	< 108	< 139	< 100
Ac-228	< 30	< 19	< 29	< 17	< 21	< 16
Th-228	< 12	< 12	< 12	< 8	< 10	< 7

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-9

RADIONUCLIDES IN DRINKING WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Croton 8					
DATE	01/12/21	02/17/21	03/17/21	04/05/21	05/11/21	06/07/21
RADIOCHEMICAL						
Gr-B	3 ± 1	< 2	< 2	5 ± 2	< 3	< 2
H-3 (a)						< 182
GAMMA						
Be-7	< 46	< 39	< 54	< 57	< 48	< 38
K-40	< 133	< 93	< 101	< 104	< 120	< 83
Mn-54	< 6	< 5	< 8	< 7	< 5	< 5
Co-58	< 8	< 5	< 7	< 7	< 5	< 5
Fe-59	< 14	< 9	< 15	< 9	< 12	< 10
Co-60	< 6	< 5	< 8	< 6	< 5	< 7
Zn-65	< 12	< 12	< 11	< 10	< 12	< 10
Nb-95	< 8	< 5	< 7	< 7	< 6	< 5
Zr-95	< 9	< 9	< 13	< 12	< 12	< 7
Ru-103	< 7	< 6	< 5	< 6	< 5	< 5
Ru-106	< 67	< 46	< 49	< 61	< 53	< 38
I-131	< 8	< 9	< 9	< 8	< 6	< 5
Cs-134	< 8	< 5	< 7	< 7	< 7	< 5
Cs-137	< 8	< 5	< 7	< 6	< 6	< 6
Ba-140	< 19	< 21	< 27	< 26	< 20	< 14
La-140	< 6	< 8	< 7	< 5	< 9	< 8
Ce-141	< 9	< 7	< 12	< 9	< 11	< 8
Ce-144	< 47	< 30	< 40	< 41	< 49	< 27
Ra-226	< 160	< 105	< 159	< 148	< 160	< 117
Ac-228	< 31	< 18	< 23	< 25	< 28	< 18
Th-228	< 12	< 8	< 13	< 10	< 13	< 8

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-9

RADIONUCLIDES IN DRINKING WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Croton 8					
DATE	07/12/21	08/10/21	09/14/21	10/11/21	11/08/21	12/14/21
RADIOCHEMICAL						
Gr-B	3 ± 2	< 2	< 2	< 2	3 ± 1	4 ± 2
H-3 (a)			< 183			< 193
GAMMA						
Be-7	< 51	< 48	< 59	< 31	< 33	< 43
K-40	< 136	< 87	< 132	< 64	< 67	< 101
Mn-54	< 6	< 4	< 7	< 4	< 4	< 4
Co-58	< 6	< 5	< 6	< 3	< 4	< 5
Fe-59	< 14	< 10	< 14	< 7	< 8	< 10
Co-60	< 6	< 6	< 8	< 4	< 4	< 4
Zn-65	< 13	< 12	< 8	< 7	< 9	< 11
Nb-95	< 6	< 6	< 7	< 4	< 4	< 5
Zr-95	< 7	< 9	< 11	< 6	< 7	< 7
Ru-103	< 5	< 6	< 6	< 3	< 4	< 5
Ru-106	< 55	< 56	< 63	< 33	< 47	< 43
I-131	< 7	< 7	< 7	< 4	< 5	< 6
Cs-134	< 6	< 5	< 5	< 4	< 5	< 5
Cs-137	< 6	< 7	< 5	< 4	< 5	< 5
Ba-140	< 22	< 15	< 22	< 14	< 18	< 20
La-140	< 9	< 5	< 8	< 5	< 5	< 6
Ce-141	< 9	< 10	< 10	< 7	< 7	< 8
Ce-144	< 43	< 45	< 45	< 27	< 28	< 36
Ra-226	< 160	< 155	< 164	< 103	< 99	< 129
Ac-228	< 35	< 23	< 22	< 14	< 15	< 17
Th-228	< 13	< 10	< 11	< 7	< 7	< 9

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-10

GAMMA EMITTERS IN SOIL SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Roseton 23*	Training Building 94	Met Tower 95
DATE	09/13/21	09/13/21	09/13/21
Be-7	< 793	< 739	< 613
K-40	14750 ± 1948	11970 ± 1713	8669 ± 1253
Mn-54	< 87	< 79	< 66
Co-58	< 84	< 80	< 55
Fe-59	< 151	< 149	< 129
Co-60	< 92	< 84	< 60
Zn-65	< 198	< 178	< 153
Nb-95	< 97	< 78	< 56
Zr-95	< 151	< 136	< 97
Ru-103	< 81	< 62	< 49
Ru-106	< 866	< 603	< 572
I-131	< 96	< 79	< 69
Cs-134	< 96	< 102	< 67
Cs-137	< 103	< 94	< 70
Ba-140	< 317	< 292	< 257
La-140	< 127	< 122	< 67
Ce-141	< 110	< 85	< 90
Ce-144	< 434	< 316	< 361
Ra-226	< 1944	< 1684	< 1263
Th-228	715 ± 189	589 ± 116	< 103

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	05/17/21	05/17/21	05/17/21	06/21/21	06/21/21	06/21/21
GAMMA						
Be-7	1152 ± 258	< 322	1052 ± 274	2324 ± 419	1009 ± 305	1640 ± 272
K-40	7444 ± 760	3426 ± 606	4446 ± 618	5838 ± 823	5048 ± 660	4256 ± 506
Mn-54	< 29	< 27	< 23	< 35	< 26	< 18
Co-58	< 26	< 19	< 19	< 31	< 22	< 14
Fe-59	< 59	< 50	< 54	< 59	< 51	< 36
Co-60	< 28	< 30	< 26	< 36	< 30	< 22
Zn-65	< 72	< 63	< 65	< 79	< 60	< 54
Nb-95	< 25	< 33	< 24	< 30	< 25	< 16
Zr-95	< 51	< 42	< 43	< 49	< 44	< 35
Ru-103	< 23	< 25	< 26	< 29	< 22	< 19
Ru-106	< 230	< 236	< 193	< 318	< 197	< 179
I-131	< 31	< 30	< 31	< 30	< 29	< 19
Cs-134	< 33	< 26	< 27	< 37	< 32	< 24
Cs-137	< 26	< 26	< 29	< 30	< 25	< 22
Ba-140	< 79	< 95	< 90	< 122	< 108	< 80
La-140	< 31	< 7	< 28	< 31	< 34	< 13
Ce-141	< 42	< 34	< 39	< 33	< 38	< 27
Ce-144	< 191	< 131	< 177	< 153	< 158	< 109
Ra-226	< 694	< 440	< 654	< 685	< 655	< 473
Th-228	< 53	< 42	< 53	< 50	< 48	< 37

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	07/19/21	07/19/21	07/19/21	08/16/21	08/16/21	08/16/21
GAMMA						
Be-7	2857 ± 346	4521 ± 444	1119 ± 339	1989 ± 321	1154 ± 309	4092 ± 362
K-40	5559 ± 617	4640 ± 674	4731 ± 748	4817 ± 577	5655 ± 700	4470 ± 565
Mn-54	< 20	< 27	< 29	< 22	< 26	< 24
Co-58	< 25	< 19	< 29	< 22	< 26	< 21
Fe-59	< 54	< 48	< 65	< 49	< 51	< 60
Co-60	< 26	< 25	< 33	< 30	< 28	< 29
Zn-65	< 67	< 57	< 61	< 61	< 63	< 60
Nb-95	< 21	< 24	< 27	< 24	< 31	< 25
Zr-95	< 44	< 48	< 47	< 40	< 48	< 32
Ru-103	< 26	< 27	< 21	< 19	< 22	< 23
Ru-106	< 217	< 261	< 257	< 196	< 254	< 250
I-131	< 33	< 33	< 36	< 28	< 33	< 25
Cs-134	< 27	< 26	< 30	< 26	< 34	< 26
Cs-137	< 25	< 32	< 29	< 25	< 34	< 22
Ba-140	< 92	< 112	< 98	< 84	< 110	< 97
La-140	< 14	< 30	< 35	< 23	< 25	< 33
Ce-141	< 40	< 48	< 33	< 32	< 39	< 36
Ce-144	< 158	< 191	< 143	< 127	< 183	< 138
Ra-226	< 640	< 689	< 574	< 538	< 761	< 565
Th-228	< 50	< 53	< 39	< 59	< 55	< 53

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	09/20/21	09/20/21	09/20/21	10/18/21	10/18/21	10/18/21
GAMMA						
Be-7	2068 ± 454	3834 ± 545	5319 ± 497	3146 ± 399	1632 ± 282	3355 ± 358
K-40	4042 ± 654	2925 ± 640	4307 ± 686	2381 ± 570	4113 ± 562	5372 ± 644
Mn-54	< 26	< 37	< 28	< 23	< 24	< 20
Co-58	< 27	< 34	< 28	< 29	< 27	< 17
Fe-59	< 55	< 65	< 58	< 52	< 55	< 52
Co-60	< 33	< 33	< 21	< 33	< 27	< 29
Zn-65	< 51	< 49	< 51	< 62	< 49	< 48
Nb-95	< 30	< 31	< 25	< 31	< 19	< 19
Zr-95	< 45	< 71	< 46	< 39	< 37	< 30
Ru-103	< 31	< 31	< 29	< 28	< 19	< 21
Ru-106	< 235	< 252	< 214	< 303	< 208	< 197
I-131	< 36	< 36	< 37	< 38	< 26	< 30
Cs-134	< 32	< 37	< 24	< 30	< 27	< 22
Cs-137	< 26	< 38	< 31	< 31	< 25	< 20
Ba-140	< 114	< 126	< 87	< 123	< 92	< 82
La-140	< 30	< 37	< 33	< 38	< 30	< 17
Ce-141	< 44	< 45	< 47	< 42	< 36	< 38
Ce-144	< 195	< 180	< 198	< 185	< 176	< 157
Ra-226	< 698	< 877	< 687	< 688	< 583	< 536
Th-228	< 54	< 64	< 60	< 52	< 45	< 43

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Training Center 94					
DATE	05/18/21	05/18/21	05/18/21	06/22/21	06/22/21	06/22/21
GAMMA						
Be-7	886 ± 245	1076 ± 279	758 ± 328	1574 ± 208	779 ± 232	763 ± 244
K-40	5587 ± 586	2858 ± 519	4094 ± 564	6101 ± 506	3136 ± 440	2224 ± 467
Mn-54	< 27	< 20	< 26	< 19	< 23	< 25
Co-58	< 23	< 18	< 27	< 21	< 19	< 26
Fe-59	< 46	< 56	< 59	< 44	< 38	< 44
Co-60	< 33	< 27	< 17	< 23	< 19	< 24
Zn-65	< 54	< 59	< 54	< 52	< 35	< 45
Nb-95	< 25	< 21	< 25	< 20	< 20	< 25
Zr-95	< 38	< 34	< 44	< 38	< 30	< 33
Ru-103	< 24	< 20	< 25	< 18	< 23	< 23
Ru-106	< 183	< 201	< 217	< 151	< 193	< 191
I-131	< 26	< 29	< 26	< 21	< 26	< 26
Cs-134	< 30	< 30	< 25	< 22	< 24	< 26
Cs-137	< 22	< 24	< 23	< 21	< 19	< 22
Ba-140	< 67	< 78	< 94	< 67	< 85	< 95
La-140	< 20	< 28	< 24	< 18	< 26	< 24
Ce-141	< 36	< 35	< 33	< 26	< 29	< 35
Ce-144	< 138	< 153	< 150	< 103	< 115	< 142
Ra-226	< 571	< 587	< 512	< 432	< 500	< 548
Th-228	< 39	< 50	< 46	< 40	< 37	< 54

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Training Center 94					
DATE	07/20/21	07/20/21	07/20/21	08/17/21	08/17/21	08/17/21
GAMMA						
Be-7	1358 ± 280	3719 ± 431	1498 ± 284	2056 ± 339	1549 ± 384	2668 ± 391
K-40	3114 ± 547	2758 ± 447	2872 ± 423	3121 ± 637	3473 ± 568	5876 ± 732
Mn-54	< 26	< 26	< 23	< 22	< 25	< 29
Co-58	< 18	< 22	< 22	< 26	< 28	< 24
Fe-59	< 51	< 34	< 48	< 56	< 60	< 45
Co-60	< 21	< 21	< 30	< 33	< 25	< 21
Zn-65	< 48	< 51	< 55	< 51	< 58	< 54
Nb-95	< 27	< 25	< 26	< 24	< 25	< 25
Zr-95	< 43	< 42	< 39	< 48	< 36	< 42
Ru-103	< 23	< 24	< 20	< 27	< 22	< 24
Ru-106	< 185	< 204	< 214	< 257	< 265	< 231
I-131	< 26	< 28	< 26	< 29	< 28	< 29
Cs-134	< 28	< 17	< 27	< 30	< 33	< 29
Cs-137	< 23	< 26	< 26	< 29	< 30	< 32
Ba-140	< 94	< 88	< 81	< 121	< 102	< 104
La-140	< 17	< 23	< 31	< 24	< 36	< 28
Ce-141	< 33	< 37	< 35	< 38	< 39	< 44
Ce-144	< 142	< 168	< 136	< 155	< 179	< 198
Ra-226	< 537	< 627	< 558	< 745	< 678	< 692
Th-228	< 46	< 49	< 42	< 68	< 66	99 ± 46

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Training Center 94					
DATE	09/21/21	09/21/21	09/21/21	10/19/21	10/19/21	10/19/21
GAMMA						
Be-7	1472 ± 356	2908 ± 543	4129 ± 541	2315 ± 302	1597 ± 370	5935 ± 537
K-40	3048 ± 710	4275 ± 716	5496 ± 816	5134 ± 604	2959 ± 551	5677 ± 764
Mn-54	< 37	< 48	< 34	< 31	< 31	< 28
Co-58	< 26	< 42	< 26	< 23	< 31	< 28
Fe-59	< 53	< 86	< 75	< 60	< 52	< 61
Co-60	< 42	< 43	< 44	< 27	< 32	< 40
Zn-65	< 75	< 75	< 81	< 56	< 64	< 62
Nb-95	< 27	< 35	< 30	< 21	< 33	< 20
Zr-95	< 48	< 67	< 62	< 44	< 55	< 51
Ru-103	< 28	< 35	< 33	< 24	< 30	< 25
Ru-106	< 295	< 324	< 260	< 252	< 227	< 255
I-131	< 35	< 41	< 41	< 30	< 39	< 27
Cs-134	< 45	< 52	< 41	< 25	< 33	< 24
Cs-137	< 40	< 38	< 36	< 27	< 29	< 25
Ba-140	< 112	< 167	< 137	< 87	< 95	< 107
La-140	< 50	< 49	< 30	< 23	< 33	< 32
Ce-141	< 43	< 53	< 53	< 40	< 40	< 43
Ce-144	< 184	< 235	< 236	< 168	< 210	< 175
Ra-226	< 726	< 957	< 802	< 649	< 686	< 650
Th-228	< 68	< 77	< 73	< 52	< 63	< 52

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Met Tower 95					
DATE	05/18/21	05/18/21	05/18/21	06/22/21	06/22/21	06/22/21
GAMMA						
Be-7	1153 ± 204	764 ± 252	892 ± 225	1107 ± 230	868 ± 198	1331 ± 264
K-40	3620 ± 451	6815 ± 859	6840 ± 640	6201 ± 597	3633 ± 439	3843 ± 586
Mn-54	< 18	< 29	< 22	< 23	< 19	< 21
Co-58	< 19	< 24	< 21	< 25	< 18	< 20
Fe-59	< 32	< 56	< 49	< 50	< 37	< 38
Co-60	< 21	< 25	< 25	< 23	< 22	< 25
Zn-65	< 41	< 58	< 51	< 54	< 47	< 40
Nb-95	< 19	< 28	< 17	< 28	< 18	< 22
Zr-95	< 33	< 45	< 30	< 42	< 32	< 41
Ru-103	< 14	< 25	< 23	< 26	< 20	< 20
Ru-106	< 197	< 190	< 180	< 198	< 164	< 204
I-131	< 20	< 25	< 24	< 25	< 21	< 16
Cs-134	< 15	< 30	< 26	< 26	< 22	< 22
Cs-137	< 17	< 26	< 25	< 26	< 21	< 19
Ba-140	< 68	< 94	< 82	< 96	< 67	< 73
La-140	< 16	< 23	< 19	< 21	< 21	< 19
Ce-141	< 26	< 34	< 31	< 33	< 29	< 27
Ce-144	< 101	< 134	< 143	< 152	< 132	< 112
Ra-226	< 420	< 507	< 479	< 550	< 496	< 470
Th-228	< 30	< 43	< 45	< 46	< 40	< 38

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Met Tower 95					
DATE	07/19/21	07/19/21	07/19/21	08/17/21	08/17/21	08/17/21
GAMMA						
Be-7	4524 ± 382	1306 ± 321	2884 ± 396	2376 ± 319	1987 ± 424	1460 ± 341
K-40	6970 ± 649	6118 ± 781	3285 ± 549	6274 ± 769	6249 ± 804	4640 ± 846
Mn-54	< 21	< 23	< 27	< 34	< 33	< 33
Co-58	< 19	< 26	< 25	< 21	< 32	< 33
Fe-59	< 47	< 53	< 49	< 41	< 63	< 74
Co-60	< 27	< 24	< 24	< 33	< 39	< 46
Zn-65	< 48	< 72	< 64	< 64	< 54	< 64
Nb-95	< 20	< 26	< 28	< 28	< 34	< 30
Zr-95	< 34	< 50	< 43	< 39	< 53	< 51
Ru-103	< 22	< 26	< 25	< 23	< 28	< 34
Ru-106	< 222	< 254	< 257	< 233	< 311	< 253
I-131	< 27	< 32	< 35	< 33	< 31	< 31
Cs-134	< 28	< 26	< 29	< 28	< 36	< 38
Cs-137	< 25	< 30	< 30	< 30	< 35	< 37
Ba-140	< 89	< 96	< 115	< 74	< 110	< 87
La-140	< 19	< 37	< 31	< 27	< 36	< 27
Ce-141	< 28	< 40	< 42	< 31	< 47	< 40
Ce-144	< 131	< 172	< 166	< 142	< 189	< 165
Ra-226	< 524	< 614	< 649	< 605	< 614	< 665
Th-228	< 37	< 49	< 51	< 39	< 70	114 ± 66

INDIAN POINT ENERGY CENTER

TABLE B-11

GAMMA EMITTERS IN BROAD LEAF VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Met Tower 95					
DATE	09/20/21	09/20/21	09/20/21	10/19/21	10/19/21	10/19/21
GAMMA						
Be-7	4266 ± 568	3871 ± 565	4224 ± 600	964 ± 239	3496 ± 269	2277 ± 354
K-40	10050 ± 993	6231 ± 854	3565 ± 720	4309 ± 544	6634 ± 488	6209 ± 773
Mn-54	< 32	< 37	< 34	< 22	< 16	< 32
Co-58	< 39	< 41	< 40	< 18	< 19	< 30
Fe-59	< 87	< 62	< 95	< 42	< 40	< 66
Co-60	< 44	< 48	< 44	< 19	< 20	< 36
Zn-65	< 92	< 84	< 88	< 47	< 43	< 74
Nb-95	< 39	< 34	< 44	< 22	< 18	< 25
Zr-95	< 75	< 73	< 71	< 36	< 32	< 54
Ru-103	< 41	< 33	< 35	< 18	< 17	< 32
Ru-106	< 347	< 358	< 391	< 185	< 172	< 236
I-131	< 47	< 36	< 51	< 25	< 22	< 33
Cs-134	< 41	< 47	< 37	< 24	< 21	< 35
Cs-137	< 43	< 41	< 33	< 22	< 18	< 29
Ba-140	< 150	< 127	< 145	< 83	< 74	< 100
La-140	< 29	< 37	< 39	< 20	< 19	< 34
Ce-141	< 64	< 52	< 66	< 29	< 29	< 39
Ce-144	< 251	< 192	< 279	< 136	< 127	< 184
Ra-226	< 1040	< 826	< 1093	< 495	< 475	< 689
Th-228	169 ± 69	< 62	< 76	< 43	< 38	< 61

INDIAN POINT ENERGY CENTER

TABLE B-12

RADIONUCLIDES IN RIVER WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Discharge Canal 10					
DATE	01/26/21	02/23/21	03/30/21	04/27/21	06/02/21	07/07/21
RADIOCHEMICAL						
H-3 (a)			483 ± 128			214 ± 122
GAMMA						
K-40	< 23	< 24	< 38	< 60	< 27	27 ± 16
Mn-54	< 1	< 2	< 2	< 5	< 1	< 1
Co-58	< 2	< 3	< 2	< 4	< 2	< 1
Fe-59	< 3	< 6	< 5	< 10	< 4	< 3
Co-60	< 2	< 3	< 2	< 4	< 2	< 1
Zn-65	< 3	< 6	< 4	< 8	< 4	< 2
Nb-95	< 2	< 2	< 2	< 4	< 2	< 1
Zr-95	< 3	< 5	< 4	< 7	< 4	< 2
Ru-103	< 2	< 3	< 3	< 5	< 2	< 2
Ru-106	< 13	< 22	< 18	< 39	< 15	< 12
I-131	< 5	< 9	< 11	< 15	< 11	< 6
Cs-134	< 2	< 3	< 2	< 5	< 2	< 1
Cs-137	< 2	< 3	< 2	< 4	< 2	< 1
Ba-140	< 11	< 21	< 19	< 32	< 19	< 12
La-140	< 4	< 7	< 7	< 12	< 7	< 4
Ce-141	< 3	< 5	< 5	< 10	< 4	< 3
Ce-144	< 11	< 16	< 16	< 31	< 11	< 9
Ra-226	< 32	< 56	< 52	< 109	< 39	< 26
Ac-228	< 6	< 9	< 8	< 16	< 6	< 4
Th-228	< 3	< 4	< 4	< 8	< 3	< 3

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-12

RADIONUCLIDES IN RIVER WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Discharge Canal 10					
DATE	08/03/21	08/31/21	09/28/21	10/26/21	11/30/21	12/29/21
RADIOCHEMICAL						
H-3 (a)			442 ± 129			< 170
GAMMA						
K-40	< 21	< 30	< 27	< 90	< 15	< 15
Mn-54	< 1	< 2	< 2	< 4	< 1	< 1
Co-58	< 1	< 2	< 2	< 5	< 2	< 2
Fe-59	< 3	< 4	< 4	< 12	< 4	< 4
Co-60	< 1	< 2	< 2	< 5	< 2	< 1
Zn-65	< 3	< 3	< 4	< 10	< 3	< 3
Nb-95	< 2	< 2	< 2	< 5	< 2	< 2
Zr-95	< 3	< 3	< 3	< 9	< 3	< 3
Ru-103	< 2	< 2	< 2	< 5	< 2	< 2
Ru-106	< 13	< 15	< 16	< 38	< 15	< 14
I-131	< 5	< 7	< 6	< 15	< 8	< 8
Cs-134	< 2	< 2	< 2	< 4	< 2	< 2
Cs-137	< 1	< 2	< 2	< 4	< 2	< 2
Ba-140	< 10	< 14	< 14	< 36	< 15	< 15
La-140	< 4	< 4	< 4	< 13	< 5	< 5
Ce-141	< 3	< 4	< 4	< 9	< 4	< 4
Ce-144	< 9	< 12	< 12	< 31	< 11	< 11
Ra-226	< 28	< 41	< 39	< 111	< 33	< 40
Ac-228	< 5	< 7	< 7	< 18	< 6	< 5
Th-228	< 2	< 3	10 ± 3	< 8	< 3	< 3

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-12

RADIONUCLIDES IN RIVER WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Roseton 23*					
DATE	01/25/21	02/22/21	03/29/21	04/26/21	06/01/21	07/06/21
RADIOCHEMICAL						
H-3 (a)			< 175			< 180
GAMMA						
K-40	< 16	< 35	< 14	< 46	< 15	< 15
Mn-54	< 1	< 2	< 2	< 3	< 2	< 2
Co-58	< 1	< 2	< 2	< 3	< 2	< 2
Fe-59	< 3	< 5	< 4	< 8	< 5	< 4
Co-60	< 1	< 2	< 2	< 3	< 2	< 2
Zn-65	< 2	< 5	< 3	< 6	< 3	< 3
Nb-95	< 1	< 3	< 2	< 3	< 2	< 2
Zr-95	< 2	< 4	< 3	< 7	< 3	< 3
Ru-103	< 1	< 3	< 2	< 4	< 2	< 2
Ru-106	< 9	< 18	< 14	< 23	< 15	< 15
I-131	< 4	< 9	< 10	< 13	< 12	< 9
Cs-134	< 1	< 2	< 2	< 4	< 2	< 2
Cs-137	< 1	< 2	< 2	< 4	< 2	< 2
Ba-140	< 9	< 17	< 16	< 26	< 19	< 16
La-140	< 3	< 7	< 5	< 9	< 6	< 6
Ce-141	< 2	< 4	< 4	< 7	< 4	< 4
Ce-144	< 5	< 14	< 12	< 22	< 10	< 13
Ra-226	< 16	< 54	< 43	< 79	< 33	< 39
Ac-228	< 4	< 7	< 6	< 11	< 7	< 6
Th-228	< 3	< 6	< 3	< 6	< 3	< 3

* Control Location

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-12

RADIONUCLIDES IN RIVER WATER SAMPLES - 2021

pCi/L ± 2 Sigma

	Roseton 23*					
DATE	08/02/21	08/30/21	09/27/21	10/25/21	11/29/21	12/28/21
RADIOCHEMICAL						
H-3 (a)			< 173			< 173
GAMMA						
K-40	< 14	< 14	< 38	< 41	< 16	< 29
Mn-54	< 1	< 1	< 2	< 3	< 1	< 2
Co-58	< 2	< 2	< 2	< 3	< 1	< 2
Fe-59	< 3	< 4	< 6	< 6	< 3	< 4
Co-60	< 2	< 2	< 2	< 2	< 1	< 2
Zn-65	< 3	< 3	< 4	< 6	< 2	< 4
Nb-95	< 2	< 2	< 2	< 3	< 1	< 2
Zr-95	< 3	< 3	< 5	< 5	< 2	< 3
Ru-103	< 2	< 2	< 3	< 3	< 1	< 2
Ru-106	< 14	< 14	< 21	< 25	< 10	< 16
I-131	< 6	< 7	< 8	< 11	< 6	< 9
Cs-134	< 2	< 2	< 3	< 3	< 1	< 2
Cs-137	< 2	< 2	< 2	< 3	< 1	< 2
Ba-140	< 12	< 14	< 19	< 21	< 11	< 17
La-140	< 4	< 5	< 6	< 8	< 4	< 5
Ce-141	< 4	< 4	< 5	< 6	< 2	< 4
Ce-144	< 12	< 12	< 15	< 19	< 7	< 11
Ra-226	< 35	< 41	< 57	< 67	< 27	< 41
Ac-228	< 5	< 6	< 8	< 10	< 4	< 6
Th-228	< 3	< 3	< 4	< 5	< 3	< 3

* Control Location

(a) Quarterly Composite

INDIAN POINT ENERGY CENTER

TABLE B-13

GAMMA EMITTERS IN BOTTOM SEDIMENT SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Discharge Canal 10		Off Verplanck 17	
DATE	06/15/21	08/30/21	06/15/21	08/30/21
GAMMA				
Be-7	< 355	< 612	< 561	< 476
K-40	14330 ± 1303	21400 ± 2042	16460 ± 1784	18130 ± 1411
Mn-54	< 45	< 65	< 69	< 52
Co-58	< 45	< 60	< 59	< 48
Fe-59	< 86	< 124	< 138	< 112
Co-60	< 55	< 92	< 76	< 56
Zn-65	< 106	< 175	< 151	< 137
Nb-95	< 41	< 65	< 73	< 51
Zr-95	< 78	< 114	< 117	< 90
Ru-103	< 40	< 63	< 60	< 50
Ru-106	< 423	< 566	< 600	< 509
I-131	< 43	< 102	< 72	< 100
Cs-134	< 61	< 84	< 79	< 70
Cs-137	94 ± 55	321 ± 118	< 108	141 ± 54
Ba-140	< 159	< 305	< 250	< 252
Ce-141	< 52	< 80	< 79	< 67
Ce-144	< 239	< 305	< 336	< 246
Ra-226	< 982	< 1578	2578 ± 1241	1962 ± 984
Th-228	244 ± 71	864 ± 107	776 ± 100	803 ± 88

INDIAN POINT ENERGY CENTER

TABLE B-13

GAMMA EMITTERS IN BOTTOM SEDIMENT SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Lent's Cove 28		Cold Spring 84*	
DATE	06/15/21	08/30/21	06/15/21	08/30/21
GAMMA				
Be-7	< 684	< 1074	< 690	< 980
K-40	13790 ± 1874	14720 ± 1999	20210 ± 2075	19560 ± 2036
Mn-54	< 107	< 119	< 97	< 104
Co-58	< 81	< 108	< 82	< 114
Fe-59	< 190	< 240	< 195	< 211
Co-60	< 107	< 115	< 91	< 110
Zn-65	< 202	< 228	< 207	< 215
Nb-95	< 81	< 131	< 98	< 138
Zr-95	< 153	< 211	< 168	< 200
Ru-103	< 87	< 116	< 89	< 108
Ru-106	< 624	< 906	< 836	< 936
I-131	< 84	< 187	< 97	< 187
Cs-134	< 109	< 143	< 111	< 124
Cs-137	142 ± 78	214 ± 109	< 131	257 ± 107
Ba-140	< 308	< 564	< 330	< 528
Ce-141	< 88	< 177	< 138	< 155
Ce-144	< 398	< 642	< 518	< 624
Ra-226	< 1850	< 2667	< 2229	< 1913
Th-228	724 ± 144	900 ± 197	970 ± 232	1085 ± 153

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-14

RADIONUCLIDES IN SHORELINE SOIL SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Off Verplanck 17		Lent's Cove 28	
DATE	06/02/21	09/08/21	06/02/21	09/08/21
RADIOCHEMICAL				
Sr-90	< 45	< 42	< 45	< 49
GAMMA				
Be-7	< 431	< 524	< 396	< 439
K-40	13410 ± 1311	12060 ± 1219	11950 ± 1238	12390 ± 1287
Mn-54	< 52	< 52	< 57	< 52
Co-58	< 53	< 51	< 56	< 49
Fe-59	< 117	< 97	< 106	< 94
Co-60	< 54	< 51	< 48	< 43
Zn-65	< 82	< 114	< 113	< 120
Nb-95	< 66	< 58	< 53	< 53
Zr-95	< 89	< 88	< 92	< 94
Ru-103	< 46	< 52	< 50	< 42
Ru-106	< 348	< 488	< 388	< 422
I-131	< 74	< 53	< 75	< 60
Cs-134	< 61	< 68	< 57	< 57
Cs-137	< 64	< 75	< 53	< 53
Ba-140	< 220	< 191	< 208	< 177
La-140	< 69	< 66	< 73	< 34
Ce-141	< 72	< 70	< 69	< 66
Ce-144	< 279	< 260	< 262	< 281
Ra-226	< 1226	< 1263	< 1127	< 1185
Ac-228	< 336	< 349	< 277	< 280
Th-228	384 ± 115	493 ± 97	392 ± 97	203 ± 73

INDIAN POINT ENERGY CENTER

TABLE B-14

RADIONUCLIDES IN SHORELINE SOIL SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Manitou Inlet 50*		White Beach 53	
DATE	06/02/21	09/07/21	06/02/21	09/07/21
RADIOCHEMICAL				
Sr-90	< 43	< 44	< 43	< 47
GAMMA				
Be-7	< 867	< 516	< 273	< 572
K-40	9070 ± 1502	13170 ± 1507	8047 ± 974	8639 ± 1145
Mn-54	< 81	< 54	< 36	< 66
Co-58	< 75	< 54	< 43	< 65
Fe-59	< 164	< 122	< 81	< 136
Co-60	< 80	< 61	< 45	< 66
Zn-65	< 185	< 141	< 91	< 139
Nb-95	< 103	< 69	< 38	< 69
Zr-95	< 137	< 111	< 60	< 108
Ru-103	< 78	< 60	< 29	< 48
Ru-106	< 656	< 470	< 296	< 517
I-131	< 112	< 65	< 45	< 64
Cs-134	< 112	< 68	< 41	< 69
Cs-137	< 125	< 65	< 40	< 65
Ba-140	< 362	< 213	< 161	< 198
La-140	< 108	< 68	< 42	< 75
Ce-141	< 109	< 76	< 44	< 69
Ce-144	< 412	< 301	< 171	< 288
Ra-226	2435 ± 1596	< 1114	< 786	< 1275
Ac-228	< 601	< 387	< 195	< 266
Th-228	650 ± 152	577 ± 97	< 57	< 116

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-14

RADIONUCLIDES IN SHORELINE SOIL SAMPLES - 2021

pCi/kg dry ± 2 Sigma

	Cold Spring 84*	
DATE	06/02/21	09/07/21
RADIOCHEMICAL		
Sr-90	< 45	< 46
GAMMA		
Be-7	< 450	< 413
K-40	32150 ± 2225	30250 ± 2163
Mn-54	< 67	< 62
Co-58	< 60	< 57
Fe-59	< 158	< 130
Co-60	< 62	< 75
Zn-65	< 166	< 148
Nb-95	< 64	< 70
Zr-95	< 112	< 113
Ru-103	< 48	< 55
Ru-106	< 438	< 561
I-131	< 73	< 57
Cs-134	< 84	< 70
Cs-137	< 60	< 63
Ba-140	< 249	< 231
La-140	< 68	< 45
Ce-141	< 67	< 71
Ce-144	< 274	< 279
Ra-226	< 1060	< 1203
Ac-228	< 333	< 432
Th-228	335 ± 81	486 ± 94

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-15

GAMMA EMITTERS IN AQUATIC VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Lent's Cove 28	
DATE	06/15/21 Peltandra Virginica	08/30/21 Peltandra Virginica
Be-7	< 169	386 ± 233
K-40	2212 ± 328	2134 ± 457
Mn-54	< 17	< 30
Co-58	< 14	< 31
Fe-59	< 41	< 52
Co-60	< 21	< 36
Zn-65	< 35	< 69
Nb-95	< 16	< 30
Zr-95	< 28	< 49
Ru-103	< 16	< 30
Ru-106	< 159	< 277
I-131	< 17	< 38
Cs-134	< 19	< 36
Cs-137	< 18	< 29
Ba-140	< 53	< 127
La-140	< 19	< 22
Ce-141	< 20	< 48
Ce-144	< 87	< 205
Ra-226	< 345	< 708
Ac-228	< 64	< 106
Th-228	< 29	< 60

INDIAN POINT ENERGY CENTER

TABLE B-15

GAMMA EMITTERS IN AQUATIC VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Off Verplanck 17	
DATE	06/17/21	08/30/21
Be-7	(a)	(a)
K-40		
Mn-54		
Co-58		
Fe-59		
Co-60		
Zn-65		
Nb-95		
Zr-95		
Ru-103		
Ru-106		
I-131		
Cs-134		
Cs-137		
Ba-140		
La-140		
Ce-141		
Ce-144		
Ra-226		
Ac-228		
Th-228		

(a) Refer to deviation table B-1b

INDIAN POINT ENERGY CENTER

TABLE B-15

GAMMA EMITTERS IN AQUATIC VEGETATION SAMPLES - 2021

pCi/kg wet ± 2 Sigma

	Cold Spring 84*	
DATE	06/15/21 Peltandra Virginica	08/30/21 Peltandra Virginica
Be-7	< 200	< 374
K-40	2971 ± 446	2405 ± 528
Mn-54	< 17	< 36
Co-58	< 20	< 37
Fe-59	< 32	< 67
Co-60	< 20	< 28
Zn-65	< 40	< 55
Nb-95	< 18	< 34
Zr-95	< 30	< 47
Ru-103	< 18	< 29
Ru-106	< 137	< 246
I-131	< 24	< 43
Cs-134	< 19	< 36
Cs-137	< 18	< 29
Ba-140	< 73	< 142
La-140	< 13	< 34
Ce-141	< 23	< 51
Ce-144	< 105	< 231
Ra-226	< 329	< 844
Ac-228	< 80	< 158
Th-228	< 35	< 69

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Downstream 107					
DATE	06/01/21 Striped Bass	06/01/21 Sunfish	06/01/21 Perch	06/01/21 Catfish	06/01/21 Eel	06/16/21 Blue Crab
RADIOCHEMICAL						
Ni-63	< 63	< 56	< 80	< 87	< 83	< 80
Sr-90	< 5	< 5	< 4	< 4	< 4	< 5
GAMMA						
Be-7	< 420	< 353	< 503	< 487	< 419	< 400
K-40	2505 ± 959	2209 ± 707	2424 ± 775	2426 ± 911	2605 ± 895	2713 ± 717
Mn-54	< 59	< 49	< 44	< 47	< 52	< 61
Co-58	< 53	< 46	< 54	< 53	< 38	< 58
Fe-59	< 114	< 86	< 139	< 120	< 112	< 87
Co-60	< 76	< 51	< 57	< 57	< 58	< 54
Zn-65	< 59	< 83	< 94	< 145	< 63	< 106
Nb-95	< 52	< 35	< 64	< 58	< 47	< 52
Zr-95	< 75	< 103	< 129	< 117	< 84	< 89
Ru-103	< 37	< 38	< 67	< 52	< 48	< 52
Ru-106	< 465	< 376	< 356	< 537	< 366	< 459
I-131	< 86	< 69	< 93	< 96	< 80	< 156
Cs-134	< 45	< 42	< 41	< 60	< 55	< 46
Cs-137	< 46	< 41	< 52	< 54	< 51	< 44
Ba-140	< 243	< 226	< 252	< 247	< 217	< 348
La-140	< 72	< 68	< 104	< 59	< 89	< 136
Ce-141	< 55	< 73	< 64	< 77	< 67	< 77
Ce-144	< 248	< 263	< 245	< 256	< 221	< 239
Ra-226	< 875	< 1125	< 1035	< 1186	< 949	< 896
Th-228	< 89	< 89	< 91	< 92	< 89	< 73

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Downstream 107					
DATE	08/23/21 Sunfish	08/26/21 Eel	09/01/21 Catfish	09/01/21 Perch	09/08/21 Blue Crab	09/08/21 Stripped Bass
RADIOCHEMICAL						
Ni-63	< 82	< 38	< 70	< 89	< 96	(a)
Sr-90	< 4	< 4	< 4	< 5	< 4	
GAMMA						
Be-7	< 472	< 511	< 443	< 743	< 343	
K-40	3251 ± 988	1970 ± 797	1466 ± 617	3169 ± 1087	2193 ± 936	
Mn-54	< 75	< 60	< 70	< 86	< 50	
Co-58	< 52	< 61	< 66	< 90	< 44	
Fe-59	< 118	< 109	< 134	< 138	< 110	
Co-60	< 73	< 68	< 51	< 77	< 59	
Zn-65	< 186	< 114	< 143	< 180	< 106	
Nb-95	< 71	< 61	< 67	< 106	< 51	
Zr-95	< 84	< 122	< 85	< 157	< 65	
Ru-103	< 65	< 53	< 59	< 74	< 43	
Ru-106	< 480	< 456	< 515	< 691	< 480	
I-131	< 167	< 103	< 208	< 260	< 103	
Cs-134	< 54	< 76	< 65	< 85	< 54	
Cs-137	< 76	< 56	< 66	< 81	< 50	
Ba-140	< 294	< 290	< 352	< 654	< 232	
La-140	< 114	< 99	< 104	< 173	< 86	
Ce-141	< 80	< 71	< 92	< 134	< 61	
Ce-144	< 338	< 271	< 307	< 464	< 225	
Ra-226	< 1393	< 1097	< 1016	< 1592	< 976	
Th-228	< 89	< 78	< 77	< 144	< 80	

(a) Refer to deviation table B-1b

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	06/01/21 Striped Bass	06/01/21 Sunfish	06/01/21 Catfish	06/01/21 Perch	06/01/21 Eel	06/01/21 Blue Crabs
RADIOCHEMICAL						
Ni-63	< 98	< 63	< 74	< 89	< 93	(a)
Sr-90	< 4	< 4	< 4	< 4	< 4	
GAMMA						
Be-7	< 532	< 410	< 577	< 512	< 550	
K-40	2203 ± 1252	2570 ± 871	4154 ± 973	2635 ± 1035	3037 ± 902	
Mn-54	< 76	< 60	< 72	< 56	< 61	
Co-58	< 84	< 55	< 67	< 59	< 63	
Fe-59	< 136	< 73	< 131	< 139	< 156	
Co-60	< 76	< 61	< 70	< 64	< 52	
Zn-65	< 135	< 105	< 146	< 112	< 137	
Nb-95	< 76	< 55	< 72	< 65	< 70	
Zr-95	< 119	< 96	< 125	< 146	< 122	
Ru-103	< 82	< 50	< 78	< 53	< 61	
Ru-106	< 650	< 497	< 644	< 419	< 671	
I-131	< 138	< 64	< 116	< 107	< 117	
Cs-134	< 84	< 46	< 84	< 66	< 79	
Cs-137	< 72	< 51	< 73	< 52	< 64	
Ba-140	< 361	< 310	< 378	< 264	< 323	
La-140	< 131	< 109	< 104	< 109	< 102	
Ce-141	< 97	< 63	< 96	< 66	< 97	
Ce-144	< 418	< 212	< 373	< 234	< 361	
Ra-226	< 1523	< 1017	< 1502	< 1032	< 1503	
Th-228	< 120	< 86	< 127	< 86	< 122	

* Control Location

(a) Refer to deviation table B-1b

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	08/23/21 Sunfish	08/26/21 Eel	09/01/21 Catfish	09/01/21 Perch	09/08/21 Blue Crab	09/15/21 Striped Bass
RADIOCHEMICAL						
Ni-63	< 84	< 49	< 65	< 99	< 94	< 91
Sr-90	< 4	< 4	< 4	< 5	< 4	< 5
GAMMA						
Be-7	< 589	< 641	< 478	< 436	< 592	< 502
K-40	2235 ± 937	1827 ± 1013	3072 ± 875	2287 ± 676	2780 ± 752	3784 ± 1106
Mn-54	< 73	< 82	< 50	< 48	< 62	< 57
Co-58	< 60	< 73	< 51	< 44	< 56	< 60
Fe-59	< 105	< 120	< 133	< 94	< 141	< 132
Co-60	< 69	< 74	< 29	< 47	< 68	< 67
Zn-65	< 147	< 191	< 102	< 108	< 108	< 110
Nb-95	< 57	< 77	< 58	< 45	< 47	< 74
Zr-95	< 108	< 161	< 93	< 83	< 102	< 104
Ru-103	< 54	< 70	< 71	< 50	< 61	< 52
Ru-106	< 433	< 606	< 453	< 326	< 551	< 500
I-131	< 176	< 149	< 169	< 139	< 97	< 128
Cs-134	< 69	< 74	< 63	< 39	< 73	< 71
Cs-137	< 55	< 67	< 47	< 44	< 57	< 65
Ba-140	< 405	< 344	< 381	< 322	< 322	< 404
La-140	< 139	< 131	< 119	< 127	< 117	< 133
Ce-141	< 82	< 108	< 83	< 64	< 90	< 96
Ce-144	< 271	< 412	< 244	< 203	< 298	< 312
Ra-226	< 950	< 1674	< 1065	< 954	< 1438	< 1297
Th-228	< 94	< 138	< 116	< 102	< 110	< 89

* Control Location

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Downstream 25					
DATE	06/01/21 Striped Bass	06/01/21 Perch	06/01/21 Sunfish	06/01/21 Catfish	06/01/21 Eel	06/01/21 Blue Crabs
RADIOCHEMICAL						
Ni-63	< 97	< 93	< 86	< 71	< 79	(a)
Sr-90	< 4	< 4	< 4	< 5	< 4	
GAMMA						
Be-7	< 722	< 483	< 442	< 422	< 441	
K-40	2253 ± 967	1959 ± 854	3044 ± 937	2341 ± 666	2903 ± 1014	
Mn-54	< 81	< 64	< 48	< 52	< 52	
Co-58	< 77	< 50	< 64	< 41	< 42	
Fe-59	< 133	< 116	< 141	< 110	< 124	
Co-60	< 71	< 46	< 68	< 45	< 62	
Zn-65	< 188	< 108	< 84	< 104	< 156	
Nb-95	< 80	< 68	< 70	< 52	< 49	
Zr-95	< 118	< 109	< 105	< 68	< 110	
Ru-103	< 64	< 59	< 54	< 53	< 47	
Ru-106	< 852	< 458	< 467	< 476	< 504	
I-131	< 140	< 85	< 88	< 79	< 95	
Cs-134	< 80	< 43	< 73	< 47	< 65	
Cs-137	< 88	< 55	< 64	< 44	< 56	
Ba-140	< 443	< 329	< 275	< 229	< 270	
La-140	< 87	< 88	< 68	< 64	< 76	
Ce-141	< 118	< 68	< 74	< 51	< 68	
Ce-144	< 450	< 252	< 256	< 211	< 248	
Ra-226	< 1555	< 897	< 1212	< 927	< 1084	
Th-228	< 133	< 85	< 86	< 67	< 86	

(a) Refer to deviation table B-1b

INDIAN POINT ENERGY CENTER

TABLE B-16

RADIONUCLIDES IN FISH / INVERTEBRATES - 2021

pCi/kg wet ± 2 Sigma

	Downstream 25					
DATE	08/23/21 Sunfish	08/26/21 Eel	09/01/21 Catfish	09/01/21 Perch	09/08/21 Blue Crab	09/15/21 Striped Bass
RADIOCHEMICAL						
Ni-63	< 97	< 66	< 57	< 98	< 86	< 68
Sr-90	< 4	< 4	< 4	< 5	< 4	(a)
GAMMA						
Be-7	< 643	< 490	< 585	< 460	< 424	< 810
K-40	2691 ± 1054	2593 ± 1005	2116 ± 988	1688 ± 591	1185 ± 741	3573 ± 1298
Mn-54	< 62	< 75	< 91	< 55	< 48	< 91
Co-58	< 82	< 28	< 51	< 46	< 45	< 90
Fe-59	< 156	< 116	< 151	< 99	< 101	< 248
Co-60	< 84	< 49	< 51	< 47	< 61	< 122
Zn-65	< 139	< 148	< 149	< 97	< 120	< 205
Nb-95	< 80	< 72	< 55	< 58	< 47	< 115
Zr-95	< 142	< 97	< 151	< 98	< 68	< 158
Ru-103	< 85	< 63	< 75	< 51	< 36	< 108
Ru-106	< 682	< 513	< 531	< 467	< 380	< 809
I-131	< 249	< 150	< 266	< 190	< 78	< 235
Cs-134	< 74	< 51	< 65	< 48	< 64	< 101
Cs-137	< 82	< 48	< 58	< 45	< 43	< 89
Ba-140	< 492	< 398	< 556	< 371	< 209	< 541
La-140	< 125	< 99	< 207	< 63	< 85	< 260
Ce-141	< 115	< 87	< 105	< 86	< 55	< 145
Ce-144	< 416	< 276	< 339	< 263	< 223	< 454
Ra-226	< 1602	< 1075	< 1352	< 1081	< 851	< 2023
Th-228	< 135	< 98	< 104	< 79	< 85	212 ± 119

(a) Refer to deviation table B1-b

TABLE B-17

LAND USE CENSUS - RESIDENCE AND MILCH ANIMAL RESULTS 2021

The 2021 land use census indicated there were no new residences that were closer in proximity to IPEC.

IPEC maintains a complete nearest residence survey with updated distances.

No milch animals were observed during this reporting period within the 5-mile zone. There are no animals producing milk for human consumption within five miles of Indian Point.

TABLE B-18
LAND USE CENSUS
2021

UNRESTRICTED AREA BOUNDARY AND NEAREST RESIDENCES

Sector	Compass Point	Distance to site Boundary from Unit 2 Plant Vent (meters)	Distance to site Boundary from Unit 3 Plant Vent (meters)	Distance to nearest resident, from Unit 1 superheater (meters)	Address of nearest resident, Last Census
1	N	RIVER	RIVER	1788	41 River Road Tomkins Cove
2	NNE	RIVER	RIVER	3111	Chateau Rive Apts. John St. Peekskill
3	NE	550	636	1907	211 Viewpoint Terrace, Peekskill
4	ENE	600	775	1478	1018 Lower South St. Peekskill
5	E	662	785	1371	1103 Lower South St. Peekskill
6	ESE	569	622	715	461 Broadway Buchanan
7	SE	553	564	1168	223 First St. Buchanan
8	SSE	569	551	1240	5 Pheasant's Run Buchanan
9	S	700	566	1133	320 Broadway Verplanck
10	SSW	755	480	1574	240 Eleventh St. Verplanck
11	SW	544	350	3016	8 Spring St. Tomkins Cove
12	WSW	RIVER	RIVER	2170	9 West Shore Dr. Tomkins Cove
13	W	RIVER	RIVER	1919	712 Rt. 9W Tomkins Cove
14	WNW	RIVER	RIVER	1752	770 Rt. 9W Tomkins Cove
15	NW	RIVER	RIVER	1693	807 Rt. 9W Tomkins Cove
16	NNW	RIVER	RIVER	1609	4 River Rd. Tomkins Cove

SECTION 6.0

HISTORICAL TRENDS

HISTORICAL TRENDS

The past ten years of historical data for various radionuclides and media are presented both in tabular form and graphical form to facilitate the comparison of 2021 data with historical values. Although other samples were taken and analyzed, values were only tabulated and plotted where positive indications were present.

Averaging the positive values in these tables can result in a biased high value, especially, when the radionuclide is detected in only one or two quarters for the year.

TABLE C-1
DIRECT RADIATION, ANNUAL SUMMARY
2011-2021

Average Quarterly Dose (mR/Quarter)			
Year	Inner Ring	Outer Ring	Control Location
2011	13.6	14.4	13.4
2012	13.2	13.5	12.5
2013	13.4	13.8	14.2
2014	13.7	13.6	14.2
2015	13.8	14.0	14.3
2016	14.3	14.2	15.6
2017	14.3	14.7	15.6
2018	14.0	14.4	15.3
2019	13.7	13.9	15.0
2020	14.0	14.2	15.4
2021	13.2	13.3	14.1

Historical Average 2011-2020	13.8	14.1	14.6

Figure C-1

DIRECT RADIATION, ANNUAL SUMMARY 2011-2021

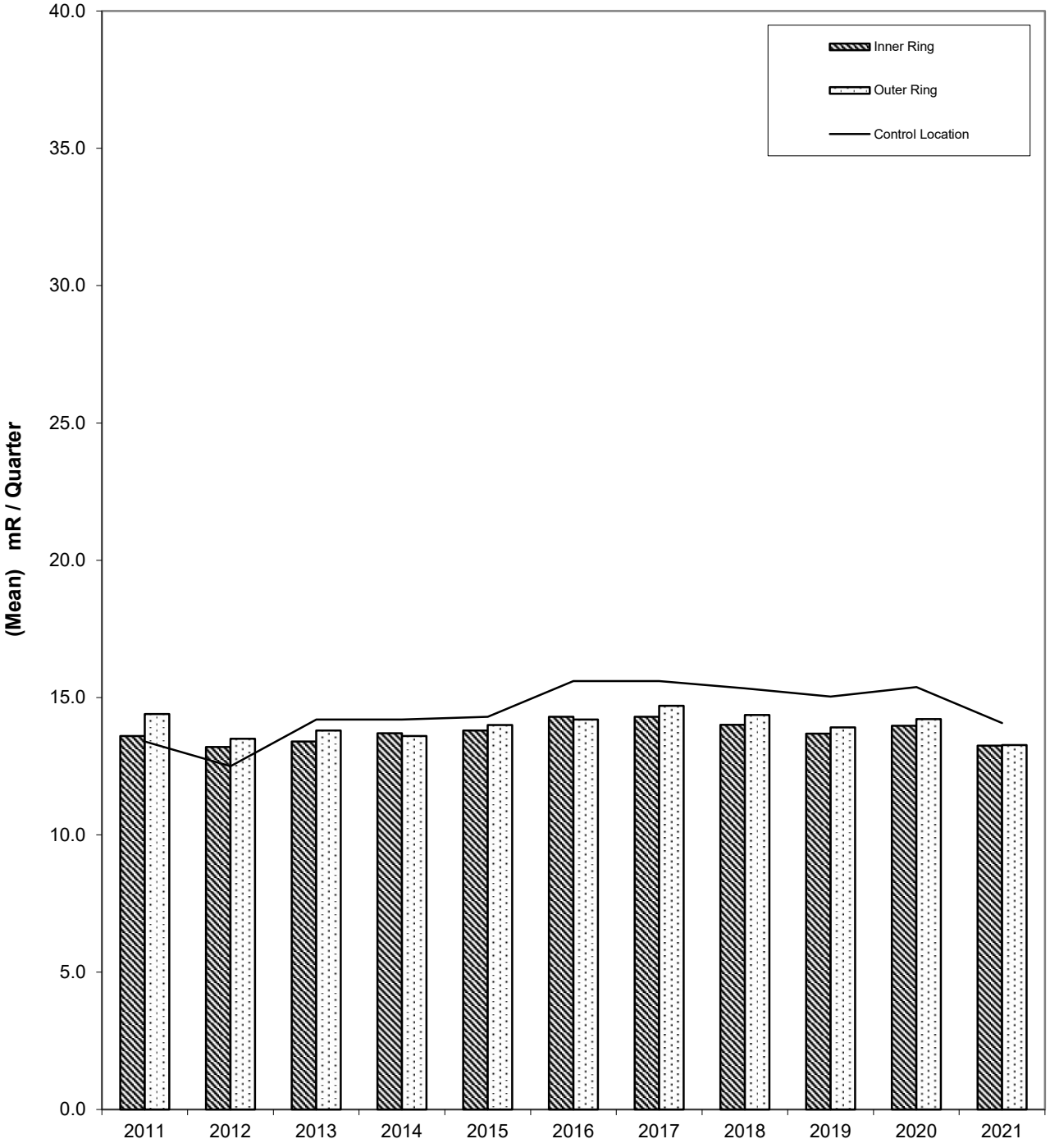


TABLE C-2
RADIONUCLIDES IN AIR
2011-2021
(pCi/m^3)

Year	Gross Beta		Cs-137	
	All Indicator Locations	Control Location	All Indicator Locations	Control Location
2011	0.014	0.014	$< L_c$	$< L_c$
2012	0.014	0.014	$< L_c$	$< L_c$
2013	0.014	0.014	$< L_c$	$< L_c$
2014	0.013	0.013	$< L_c$	$< L_c$
2015	0.016	0.015	$< L_c$	$< L_c$
2016	0.015	0.015	$< L_c$	$< L_c$
2017	0.013	0.012	$< L_c$	$< L_c$
2018	0.013	0.012	$< L_c$	$< L_c$
2019	0.012	0.012	$< L_c$	$< L_c$
2020	0.013	0.013	$< L_c$	$< L_c$
2021	0.014	0.014	$< L_c$	$< L_c$
Historical Average 2011-2020	0.01	0.01	$< L_c$	$< L_c$

Critical Level (L_c) is less than the ODCM required LLD.

$<L_c$ indicates no positive values above sample critical level.

Figure C-2

RADIONUCLIDES IN AIR - GROSS BETA
2011-2021

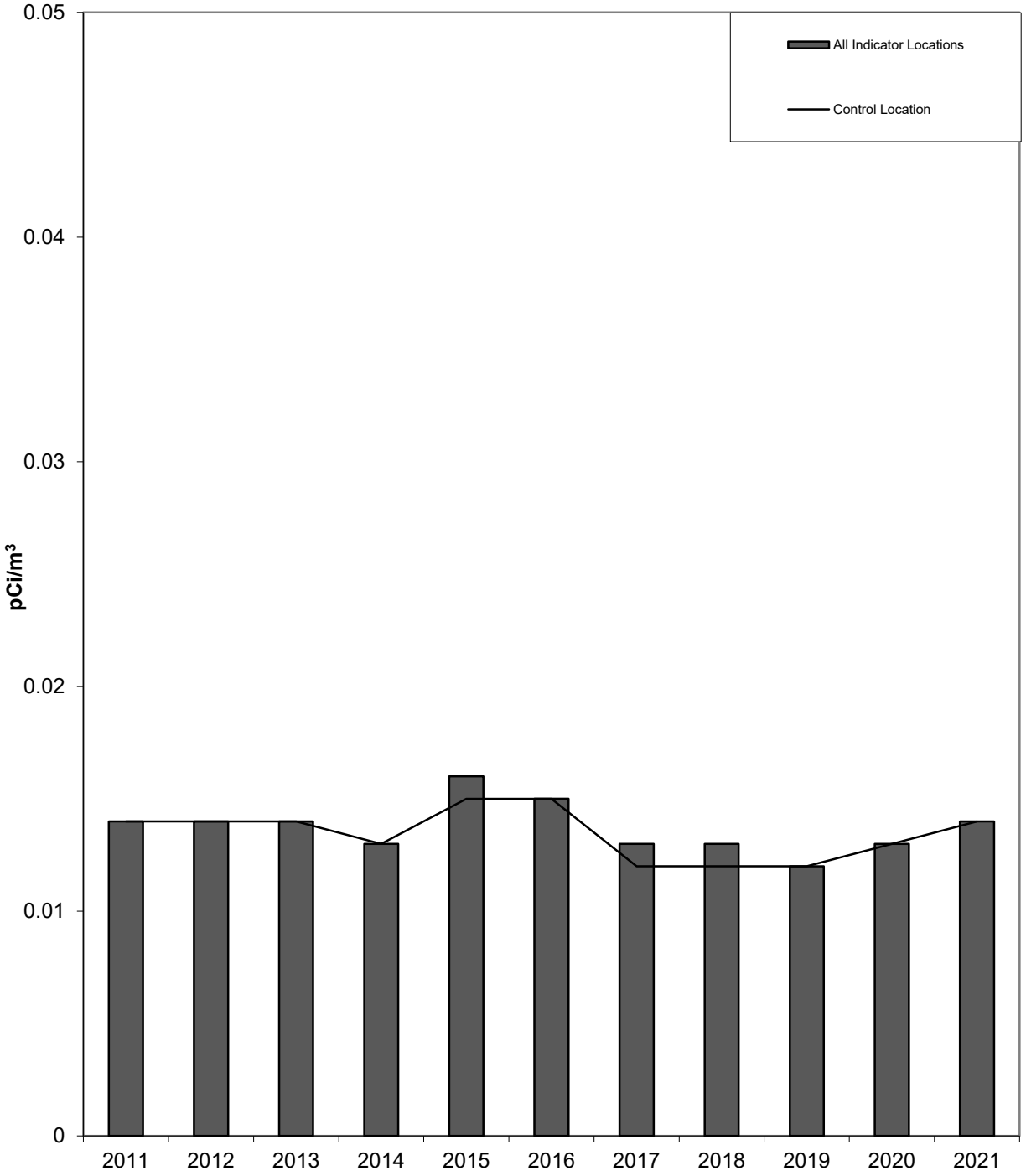


TABLE C-3
RADIONUCLIDES IN HUDSON RIVER WATER-TRITIUM
2011-2021
(pCi/L)

	Tritium (H-3)		Cs-137	
Year	Inlet	Discharge	Inlet	Discharge
2011	< L_c	661	< L_c	< L_c
2012	< L_c	539	< L_c	< L_c
2013	241	462	< L_c	< L_c
2014	224	253	< L_c	< L_c
2015	188	341	< L_c	< L_c
2016	< L_c	415	< L_c	< L_c
2017	< L_c	299	< L_c	< L_c
2018	236	266	< L_c	< L_c
2019	273	295	< L_c	< L_c
2020 (b)	< L_c	288	< L_c	< L_c
2021	< L_c	380	< L_c	< L_c
Historical Average 2011-2020	232	382	< L_c	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

(b) Refer REMP changes table B-1c

Figure C-3

RADIONUCLIDES IN HUDSON RIVER WATER - TRITIUM 2011-2021

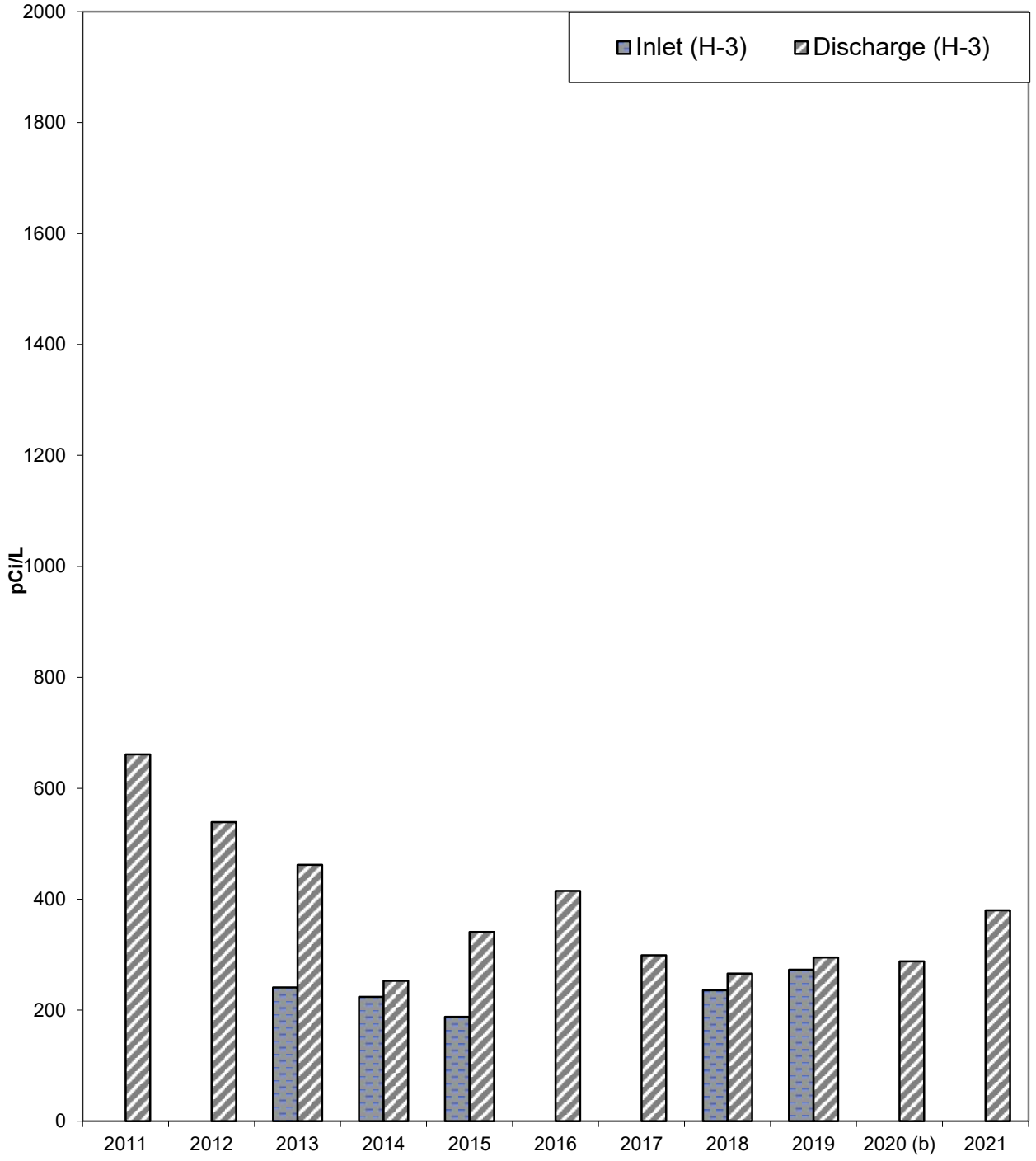


TABLE C-4
RADIONUCLIDES IN DRINKING WATER
2011-2021
(pCi/L)

Year	Tritium (H-3)	Cs-137
2011	< L_c	< L_c
2012	< L_c	< L_c
2013	< L_c	< L_c
2014	< L_c	< L_c
2015	< L_c	< L_c
2016	< L_c	< L_c
2017	< L_c	< L_c
2018	< L_c	< L_c
2019	< L_c	< L_c
2020	< L_c	< L_c
2021	< L_c	< L_c
Historical Average 2011-2020	< L_c	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

Figure C-4

RADIONUCLIDES IN DRINKING WATER
2011-2021

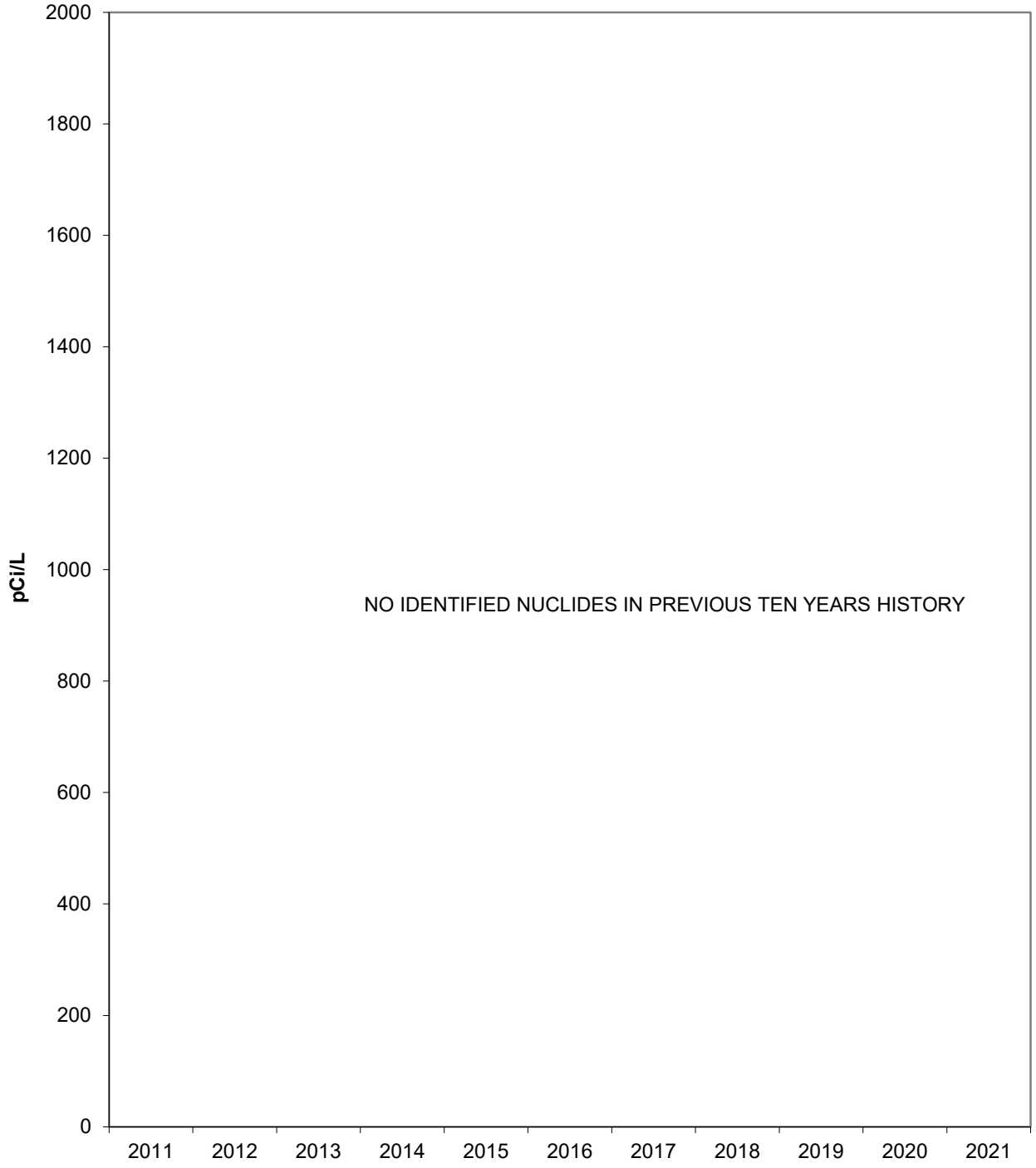


TABLE C-5
RADIONUCLIDES IN SHORELINE SOIL
2011-2021
(pCi/Kg, dry)

	Cs-134		Cs-137	
Year	Indicator	Control	Indicator	Control
2011	< L_c	< L_c	108	< L_c
2012	< L_c	< L_c	141	< L_c
2013	< L_c	< L_c	133	< L_c
2014	< L_c	< L_c	327	< L_c
2015	< L_c	< L_c	110	< L_c
2016	< L_c	< L_c	< L_c	< L_c
2017	< L_c	< L_c	151	< L_c
2018	< L_c	< L_c	129	< L_c
2019	< L_c	< L_c	104	< L_c
2020	< L_c	< L_c	96	< L_c
2021	< L_c	< L_c	< L_c	< L_c
Historical Average 2011-2020	< L_c	< L_c	144	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

Figure C-5

RADIONUCLIDES IN SHORELINE SOIL
2011-2021

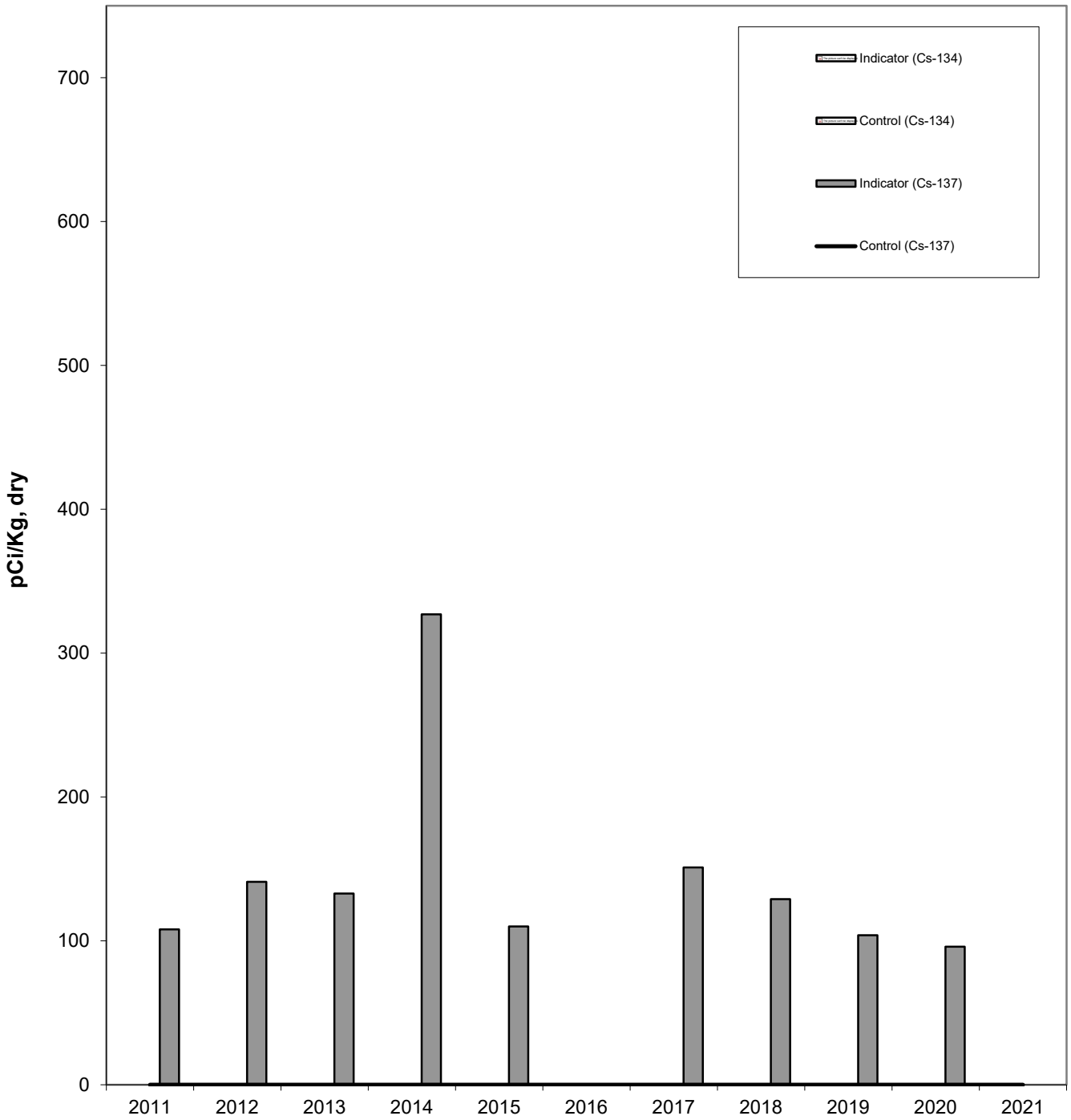


TABLE C-6
RADIONUCLIDES IN BROAD LEAF VEGETATION
2011-2021
(pCi/Kg, wet)

	Cs-137	
Year	**Indicator**	**Control**
2011	< L_c	< L_c
2012	44	< L_c
2013	< L_c	< L_c
2014	< L_c	< L_c
2015	< L_c	< L_c
2016	< L_c	< L_c
2017	< L_c	< L_c
2018	< L_c	< L_c
2019	< L_c	< L_c
2020	< L_c	< L_c
2021	< L_c	< L_c
Historical Average 2011-2020	44	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

Figure C-6

RADIONUCLIDES IN BROAD LEAF VEGETATION
2011-2021

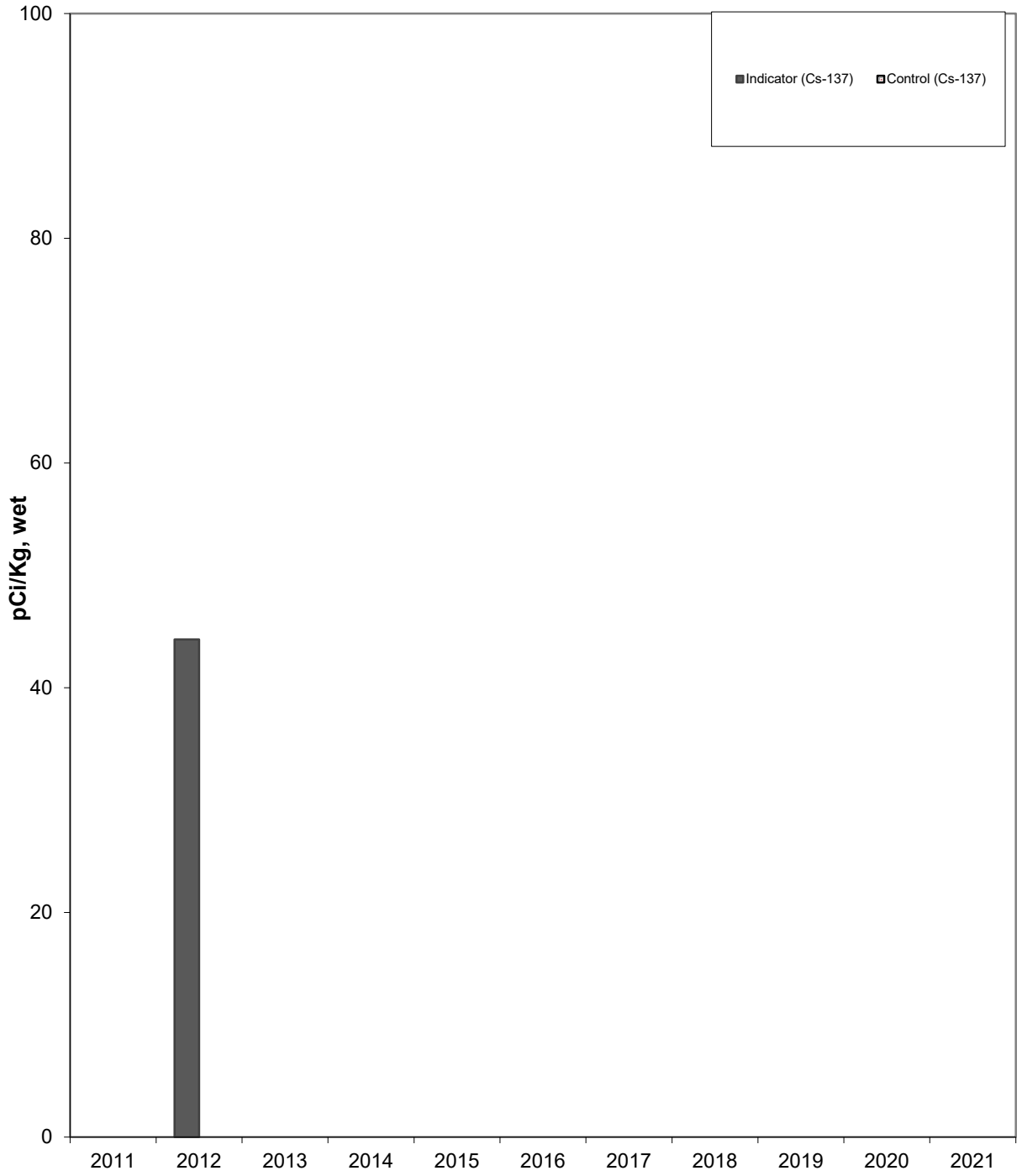


TABLE C-7
RADIONUCLIDE IN FISH AND INVERTEBRATES
2011-2021
(pCi/Kg, Wet)

	Cs-137	
Year	**Indicator**	**Control**
2011	< L_c	< L_c
2012	< L_c	< L_c
2013	< L_c	< L_c
2014	< L_c	< L_c
2015	< L_c	< L_c
2016	< L_c	< L_c
2017	< L_c	< L_c
2018	< L_c	< L_c
2019	< L_c	< L_c
2020	< L_c	< L_c
2021	< L_c	< L_c
Historical Average 2011-2020	< L_c	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

Figure C-7

RADIONUCLIDES IN FISH AND INVERTEBRATES 2011-2021

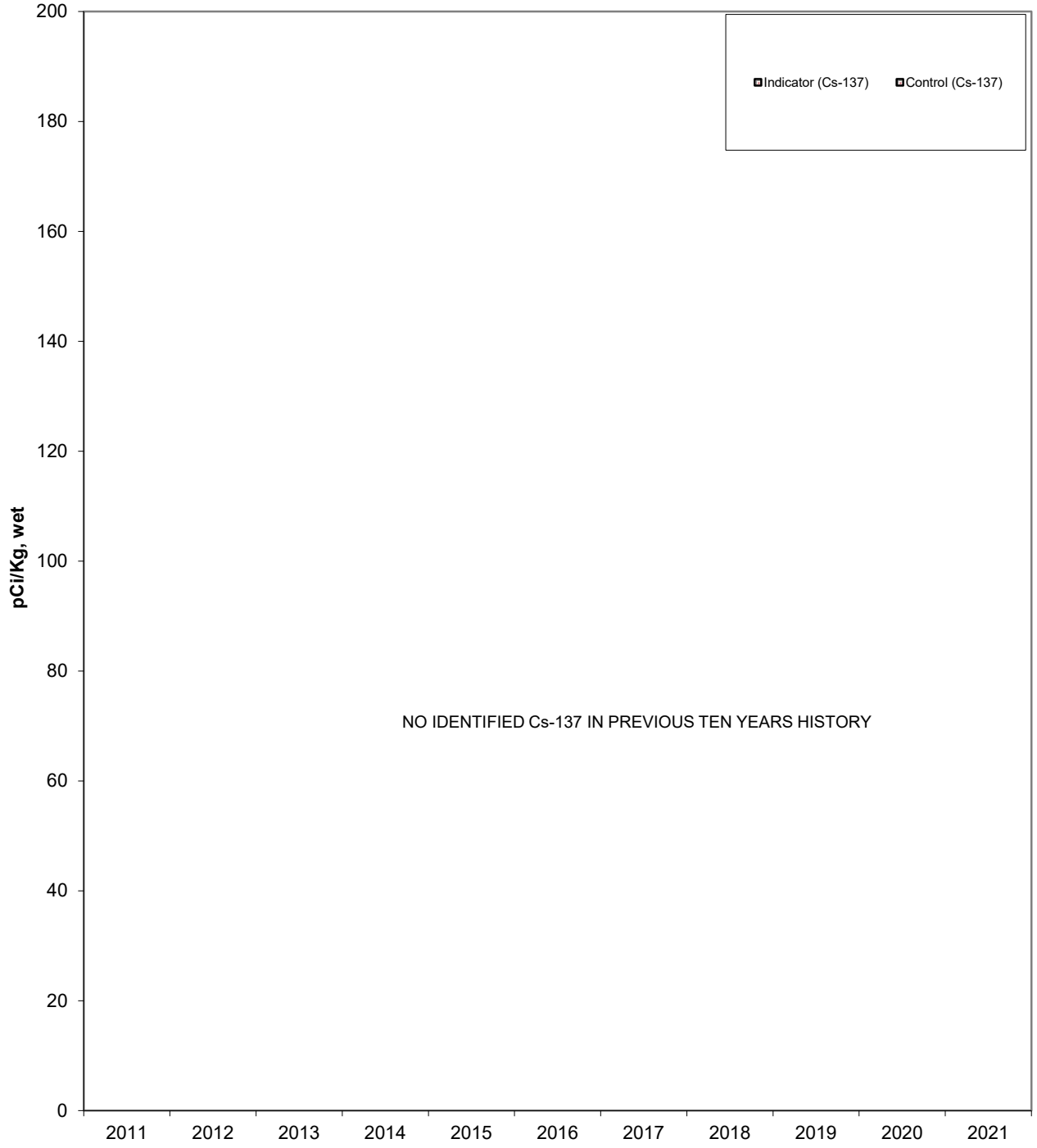


TABLE C-8
RIVER WATER - Discharge Area - Tritium
REMP vs. EFFLUENT
(pCi/L)

Year	REMP*	EFFLUENT **
1Q 2018	273	659
2Q 2018	326	439
3Q 2018	<197	332
4Q 2018	199	418
1Q 2019	296	484
2Q 2019	294	602
3Q 2019	<187	74
4Q 2019	<181	7.68
1Q 2020	347	1021
2Q 2020	<176	470
3Q 2020	<177	188
4Q 2020	229	866
1Q 2021	483	4.95
2Q 2021	214	115
3Q 2021	442	737
4Q 2021	<170	174
Four Year Average, by Quarter, 2018 - 2021	310	412

* Sample from mixing zone, expected to be less than average activity in the discharge canal.

** Based upon Effluent Report data, average activity in the discharge canal calculated from the total H-3 discharged divided by the total dilution volume for the quarter.

TABLE C-9
RADIONUCLIDES IN BOTTOM SEDIMENT
2011-2021
(pCi/Kg, dry)

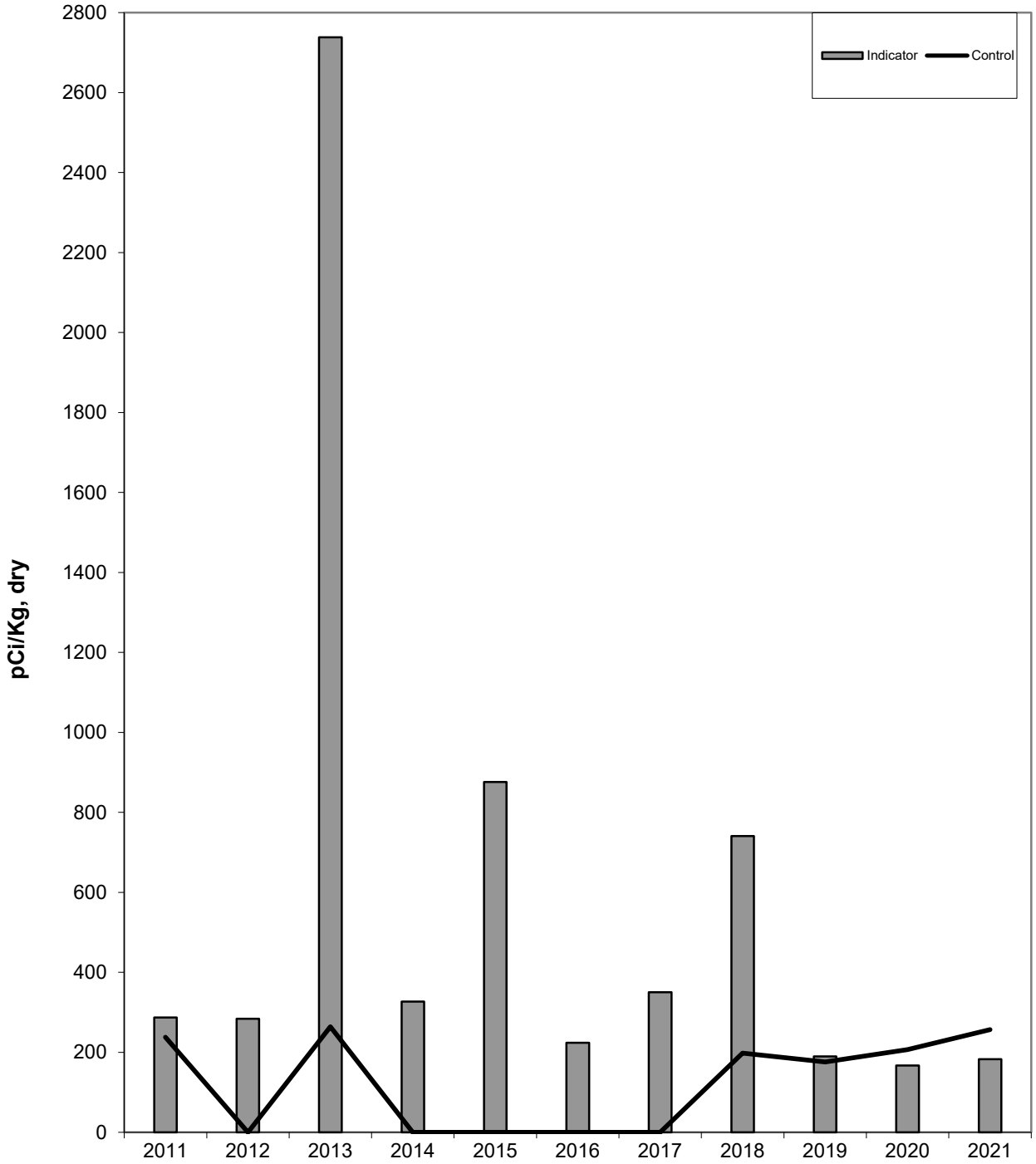
Cs-137		
Year	**Indicator**	**Control**
2011	287	238
2012	284	< L_c
2013	2738	264
2014	327	< L_c
2015	876	< L_c
2016	224	< L_c
2017	350	< L_c
2018	741	198
2019	190	176
2020	167	207
2021	183	257
Historical Average 2011-2020	618	217

Critical Level (L_c) is less than the RETS required LLD.

<L_c indicates no positive values above sample critical level.

Figure C-9

RADIONUCLIDES IN BOTTOM SEDIMENT
2011-2021



SECTION 7.0

INTERLABORATORY COMPARISON PROGRAM

INTERLABORATORY COMPARISON PROGRAM

This section presents the results of the interlaboratory comparison program for the Teledyne Brown Engineering Environmental Services and Environmental Dosimetry Company.

7.1 Program Description – Teledyne Brown Engineering Environmental Services Comparison Programs

The Teledyne Brown Engineering Environmental Services participates in several interlaboratory comparison programs. These programs include sample media for which samples are routinely collected and for which comparison samples are commercially available. Participation in these interlaboratory comparison programs ensure that independent checks on the precision and accuracy of the measurement of radioactive material in the environmental samples are performed as part of the Quality Assurance Program for environmental monitoring. To fulfill the requirement for an Interlaboratory Comparison Program, Teledyne Brown Engineering Environmental Services has engaged the following programs:

- Eckert & Ziegler Analytics Environmental Radioactivity Cross Check Program
- Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP)
- Environmental Resource Associates (ERA) Cross Check Program

These programs supply sample media as blind samples (typically spikes), which contain certified levels of radioactivity unknown to the analysis laboratory. These samples are prepared and analyzed by the Teledyne Brown Engineering Environmental Services using standard laboratory procedures. Each program issues a statistical summary report of the results. Teledyne Brown Engineering Environmental Services uses predetermined acceptance criteria methodology for evaluating its laboratory performance.

Teledyne Brown Engineering Environmental Services also analyzes laboratory blanks. The analysis of laboratory blanks provides a means to detect and measure radioactive contamination of analytical samples. The analysis of analytical blanks also provides information on the adequacy of background subtraction. Laboratory blank results are analyzed using control charts.

7.2 Acceptance Criteria

Each sample result is evaluated to determine the accuracy and precision of the laboratory's analysis result. The sample evaluation method is discussed below.

7.2.1 Analytics Sample Results Evaluation

Samples provided by Analytics are evaluated using what is specified as the NRC method. This method is based on the calculation of the ratio of results reported by the participating laboratory (QC result) to the Vendor Laboratory Known value (reference result).

An Environmental Laboratory analytical result is evaluated using the following calculation:

The value for the error resolution is calculated.

$$\text{Error Resolution} = \frac{\text{Reference Result}}{\text{Reference Results Error (1 sigma)}}$$

Using the appropriate row under the Error Resolution column in Table D-2.1, a corresponding Ratio of Agreement interval is given for use in Tables D-3.1, D-3.2, and D-3.3

The value for the ratio is then calculated.

$$\text{Ratio of agreement} = \frac{\text{QC Result}}{\text{Reference Result}}$$

If the value falls within the agreement interval, the result is acceptable.

TABLE D-2.1 Ratio of Agreement

ERROR RESOLUTION	RATIO OF AGREEMENT
< 4	No Comparison
4 to 7	0.5-2.0
8 to 15	0.6-1.66
16 to 50	0.75-1.33
51 to 200	0.8-1.25
>200	0.85-1.18

This acceptance test is generally referred to as the “NRC” method. The acceptance criteria are contained in Procedure EN-CY-102. The NRC method generally results in an acceptance range of approximately ± 25% of the Known value when applied to sample results from the Eckert & Ziegler Analytics Interlaboratory Comparison Program. This method is used as the procedurally required assessment method and requires the generation of a deviation from QA/QC program report when results are unacceptable.

7.2.2 ERA and MAPEP Sample Result Evaluation

Both these programs supply an acceptance range for evaluating the results.

7.3 Program Results Summary

The Interlaboratory Comparison Program numerical results are summarized in the following tables.

TABLE D-3.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
March 2021	E13466	Milk	Sr-89	pCi/L	84.6	87.1	0.97	A
			Sr-90	pCi/L	11.5	12.6	0.91	A
	E13467	Milk	Ce-141	pCi/L	111	125	0.89	A
			Co-58	pCi/L	123	128	0.96	A
			Co-60	pCi/L	140	154	0.91	A
			Cr-51	pCi/L	252	242	1.04	A
			Cs-134	pCi/L	130	151	0.86	A
			Cs-137	pCi/L	110	110	1.00	A
			Fe-59	pCi/L	105	109	0.96	A
			I-131	pCi/L	77.6	86.9	0.89	A
			Mn-54	pCi/L	111	112	0.99	A
			Zn-65	pCi/L	200	211	0.95	A
	E13468	Charcoal	I-131	pCi	83.5	88.5	0.94	A
	E13469	AP	Ce-141	pCi	103.0	103	1.00	A
			Co-58	pCi	93.3	105	0.89	A
			Co-60	pCi	136	126	1.08	A
			Cr-51	pCi	213	198	1.07	A
			Cs-134	pCi	123.0	124	0.99	A
			Cs-137	pCi	86.3	90.1	0.96	A
			Fe-59	pCi	81.3	89.6	0.91	A
			Mn-54	pCi	93.5	92.0	1.02	A
			Zn-65	pCi	166	173	0.96	A
	E13470	Soil	Ce-141	pCi/g	0.232	0.262	0.89	A
			Co-58	pCi/g	0.251	0.268	0.94	A
			Co-60	pCi/g	0.306	0.322	0.95	A
			Cr-51	pCi/g	0.517	0.506	1.02	A
			Cs-134	pCi/g	0.263	0.317	0.83	A
			Cs-137	pCi/g	0.278	0.301	0.92	A
			Fe-59	pCi/g	0.228	0.229	1.00	A
			Mn-54	pCi/g	0.221	0.235	0.94	A
			Zn-65	pCi/g	0.448	0.441	1.02	A
	E13471	AP	Sr-89	pCi	92.2	95.5	0.97	A
			Sr-90	pCi	11.7	13.9	0.84	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

TABLE D-3.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Known Result	Evaluation [(b)]
September 2021	E13472	Milk	Sr-89	pCi/L	66.4	85.4	0.78	W
			Sr-90	pCi/L	11.9	14.0	0.85	A
	E13473	Milk	Ce-141	pCi/L	118	114	1.03	A
			Co-58	pCi/L	116	118	0.98	A
			Co-60	pCi/L	142	145	0.98	A
			Cr-51	pCi/L	244	236	1.03	A
			Cs-134	pCi/L	81	93.1	0.87	A
			Cs-137	pCi/L	105	112	0.94	A
			Fe-59	pCi/L	105	102	1.03	A
			I-131	pCi/L	65.1	85.6	0.76	W
			Mn-54	pCi/L	128	128	1.00	A
			Zn-65	pCi/L	158	153	1.03	A
	E13474	Charcoal	I-131	pCi	85.2	90.9	0.94	A
	E13475	AP	Ce-141	pCi	126	135	0.94	A
			Co-58	pCi	148	139	1.07	A
			Co-60	pCi	183	171	1.07	A
			Cr-51	pCi	322	278	1.16	A
			Cs-134	pCi	118	110	1.08	A
			Cs-137	pCi	147	132	1.12	A
			Fe-59	pCi	131	120	1.09	A
			Mn-54	pCi	161	151	1.06	A
			Zn-65	pCi	202	180	1.12	A
	E13476	Soil	Ce-141	pCi/g	0.215	0.219	0.98	A
			Co-58	pCi/g	0.208	0.226	0.92	A
			Co-60	pCi/g	0.277	0.277	1.00	A
			Cr-51	pCi/g	0.388	0.452	0.86	A
			Cs-134	pCi/g	0.157	0.178	0.88	A
			Cs-137	pCi/g	0.270	0.284	0.95	A
			Fe-59	pCi/g	0.218	0.195	1.12	A
			Mn-54	pCi/g	0.239	0.246	0.97	A
			Zn-65	pCi/g	0.312	0.293	1.06	A
	E13477	AP	Sr-89	pCi	85.6	68.3	1.25	W
			Sr-90	pCi	12.6	11.2	1.13	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

TABLE D-3.2 DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Range	Evaluation [b]
February 2021	21-GrF44	AP	Gross Alpha	Bq/sample	0.371	1.77	0.53 - 3.01	N(3)
			Gross Beta	Bq/sample	0.731	0.65	0.325 - 0.974	A
	21-MaS44	Soil	Ni-63	Bq/kg	310	689.0	482 - 896	N(4)
			Tc-99	Bq/kg	457	638	447 - 829	W
	21-MaSU44	Urine	Cs-134	Bq/L	2.34	2.73	1.91 - 3.55	A
			Cs-137	Bq/L	2.54	2.71	1.90 - 3.52	A
			Co-57	Bq/L	0.4100		*(1)*	A
			Co-60	Bq/L	2.24	2.44	1.71 - 3.17	A
			Mn-54	Bq/L	2.03	2.03	1.42 - 2.64	A
			K-40	Bq/L	52.8	54.0	38 - 70	A
			U-234	Bq/L	0.108	0.0877	0.0614 - 0.114	W
			U-238	Bq/L	0.101	0.091	0.064 - 0.118	A
			Zn-65	Bq/L	1.06	1.34	*(2)*	A
	21-MaW44	Water	Ni-63	Bq/L	6.7	8.2	5.7 - 10.7	A
			Tc-99	Bq/L	3.850	4.01	2.81 - 5.21	A
	21-RdV44	Vegetation	Cs-134	Bq/sample	3.13	3.60	2.5 - 4.7	A
			Cs-137	Bq/sample	4.64	4.69	3.28 - 6.10	A
			Co-57	Bq/sample	5.25	5.05	3.54 - 6.57	A
			Co-60	Bq/sample	2.86	2.99	2.09 - 3.89	A
			Mn-54	Bq/sample	5.02	5.25	3.68 - 6.83	A
			Sr-90	Bq/sample	0.631	0.673	0.471 - 0.875	A
			Zn-65	Bq/sample	-0.233		*(1)*	A
August 2021	21-GrF45	AP	Gross Alpha	Bq/sample	0.368	0.960	0.288 - 1.632	A
			Gross Beta	Bq/sample	0.595	0.553	0.277 - 0.830	A
	21-MaS45	Soil	Ni-63	Bq/kg	546	1280	896 - 1664	N(5)
			Tc-99	Bq/kg	453	777	544 - 1010	N(6)
	21-MaSU45	Urine	Cs-134	Bq/L	3.10	3.62	2.53 - 4.71	A
			Cs-137	Bq/L	0.083		*(1)*	A
			Co-57	Bq/L	0.844	0.87	0.606 - 1.125	A
			Co-60	Bq/L	0.0535		*(1)*	A
			Mn-54	Bq/L	0.459	0.417	*(2)*	A
			K-40	Bq/L	48.8	54.0	38 - 70	A
			U-234	Bq/L	0.133	0.116	0.081 - 0.151	A
			U-238	Bq/L	0.137	0.121	0.085 - 0.157	A
			Zn-65	Bq/L	0.339	0.420	*(2)*	A
	21-MaW45	Water	Ni-63	Bq/L	33.5	39.5	27.7 - 51.4	A
			Tc-99	Bq/L	3.5	3.7	2.60 - 4.82	A
	21-RdV45	Vegetation	Cs-134	Bq/sample	3.42	4.34	3.04 - 5.64	W
			Cs-137	Bq/sample	2.14	2.21	1.55 - 2.87	A
			Co-57	Bq/sample	4.08	4.66	3.26 - 6.06	A
			Co-60	Bq/sample	2.81	3.51	2.46 - 4.56	A
			Mn-54	Bq/sample	0.035		*(1)*	A
			Sr-90	Bq/sample	1.15	1.320	0.92 - 1.72	A
			Zn-65	Bq/sample	2.05	2.43	1.70 - 3.16	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test
(2) Sensitivity evaluation
*(3) See **NCR 21-02***
*(4) See **NCR 21-03***
*(5) See **NCR 21-13***
(6) Tc-99 cross-checks done for TBE information only - not required

TABLE D-3.3 ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Limits	Evaluation [b]
March 2021	MRAD-34	Water	Am-241	pCi/L	175	157	108 - 201	A
			Fe-55	pCi/L	579	275	162 - 400	N(1)
			Pu-238	pCi/L	181	171	103 - 222	A
			Pu-239	pCi/L	153	142	87.9 - 175	A
		Soil	Sr-90	pCi/kg	6570	9190	2860 - 14,300	A
		AP	Fe-55	pCi/filter	107	121	44.2 - 193	A
			U-234	pCi/filter	25.99	25.5	18.9 - 29.9	A
			U-238	pCi/filter	24.7	25.3	19.1 - 30.2	A
April 2021	RAD-125	Water	Ba-133	pCi/L	92.3	90.5	76.2 - 99.6	A
			Cs-134	pCi/L	62.9	70.5	57.5 - 77.6	A
			Cs-137	pCi/L	161	168	151 - 187	A
			Co-60	pCi/L	22.5	20.9	17.7 - 25.8	A
			Zn-65	pCi/L	183	177.0	159 - 208	A
			GR-A	pCi/L	30.8	30.2	15.4 - 39.4	A
			GR-B	pCi/L	60.1	67.5	46.8 - 74.2	A
			U-Nat	pCi/L	36.45	36.9	30.0 - 40.8	A
			H-3	pCi/L	13,400	14,600	12,800 - 16,100	A
			Sr-89	pCi/L	64.5	63.5	51.4 - 71.5	A
			Sr-90	pCi/L	22.8	23.0	16.5 - 27.0	A
			I-131	pCi/L	28.2	26.7	22.2 - 31.4	A
September 2021	MRAD-35	Water	Am-241	pCi/L	68	63.7	43.7 - 81.5	A
			Fe-55	pCi/L	179	246	145 - 358	A
			Pu-238	pCi/L	102	114	68.5 - 148	A
			Pu-239	pCi/L	32	34.3	21.2 - 42.3	A
		Soil	Sr-90	pCi/kg	6160	6090	1,900 - 9,490	A
		AP	Fe-55	pCi/filter	493	548	200 - 874	A
			Pu-238	pCi/filter	28	28.5	21.5 - 35.0	A
			Pu-239	pCi/filter	21	21.6	16.1 - 26.1	A
			U-234	pCi/filter	7.95	7.76	5.75 - 9.09	A
			U-238	pCi/filter	8.0	7.69	5.81 - 9.17	A
October 2021	RAD-127	Water	Ba-133	pCi/L	82.8	87.5	73.6 - 96.2	A
			Cs-134	pCi/L	64.0	70.1	57.1 - 77.1	A
			Cs-137	pCi/L	145	156	140 - 174	A
			Co-60	pCi/L	83.2	85.9	77.3 - 96.8	A
			Zn-65	pCi/L	133	145	130 - 171	A
			GR-A	pCi/L	76.0	66.7	35.0 - 82.5	A
			GR-B	pCi/L	63.0	55.7	38.1 - 62.6	N(2)
			U-Nat	pCi/L	52.88	55.5	45.3 - 61.1	A
			H-3	pCi/L	13,800	17,200	15,000 - 18,900	N(3)
			Sr-89	pCi/L	54.9	61.0	49.1 - 68.9	A
			Sr-90	pCi/L	24.8	29.3	21.3 - 34.0	A
			I-131	pCi/L	27.4	26.4	21.9 - 31.1	A
December 2021	QR 120121Y	Water	GR-B	pCi/L	47.6	39.8	26.4 - 47.3	N(4)
			H-3	pCi/L	17,500	17,800	15,600 - 19,600	A

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation: A = Acceptable - Reported value falls within the Acceptance Limits
N = Not Acceptable - Reported value falls outside of the Acceptance Limits

*(1) See **NCR 21-01***
*(2) See **NCR 21-10***
*(3) See **NCR 21-11***
*(4) See **NCR 21-14***

7.4 Environmental TLD Quality Assurance

Environmental dosimetry services for the reporting period of January – December, 2021 were provided by the Environmental Dosimetry Company (EDC), Sterling, Massachusetts. The TLD systems at the Environmental Dosimetry Company (EDC) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to EDC clients is ensured by in house performance testing and independent performance testing by EDC clients.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of EDC dosimeters. Performance testing provides a statistical measure of the bias and precision of dosimetry processing against a reliable standard, which in turn points out any trends or performance changes. Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in house testing program conducted by the EDC QA Officer and (2) independent test perform by EDC clients.

Excluded from this report are instrumentation checks. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks in this report. Instrumentation checks represent between 5-10% of the TLDs processed.

Table D-4.1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons (Cs-137) only. The internal acceptance (tolerance) criteria for the Panasonic Environmental dosimeters are: ± 15% for bias and ± 12.8% for precision. During this period, 100% (72/72) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision.

Table D-4.2 provides the Bias + Standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Table D-4.3 presents the independent blind spike results for irradiated dosimeters provided by client utilities during this annual period. All results passed the performance acceptance criterion.

TABLE D-4.1

PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA JANUARY – DECEMBER 2021 [(1), (2)]

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

[(1)]This table summarizes results of tests conducted by EDC.
[(2)]Environmental dosimeter results are free in air.

TABLE D-4.2

MEAN DOSIMETER ANALYSES (N=6)
JANUARY – DECEMBER 2021 [(1), (2)]

Process Date	Mean Bias %	Standard Deviation %	Tolerance Limit +/-15%
5/04/2021	0.6	0.9	Pass
5/06/2021	-0.2	1.4	Pass
5/26/2021	-3.8	1.6	Pass
7/27/2021	2.8	1.4	Pass
8/04/2021	-1.8	2.3	Pass
9/14/2021	-0.2	2.3	Pass
11/01/2021	3.7	0.6	Pass
11/03/2021	1.9	1.9	Pass
11/09/2021	1.1	1.1	Pass
01/26/2022	2.6	1.9	Pass
01/30/2022	-4.2	1.1	Pass
02/06/2022	2.9	1.2	Pass

[(1)]This table summarizes results of tests conducted by EDC for TLDs issued in 2021.
[(2)]Environmental dosimeter results are free in air.

TABLE D-4.3
SUMMARY OF INDEPENDENT DOSIMETER TESTING
JANUARY – DECEMBER 2021 [(1), (2)]

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2021	SONGS	-3.8	1.4	Pass
1st Qtr. 2021	SONGS	-4.7	1.1	Pass
2nd Qtr.2021	Seabrook	3.1	1.0	Pass
3rd Qtr. 2021	Millstone	-4.7	1.4	Pass
4th Qtr.2021	PSEG(PNNL) 50mR	1.3	0.8	Pass
4th Qtr.2021	PSEG(PNNL) 100mR	1.8	0.8	Pass
4th Qtr.2021	PSEG(PNNL) 150mR	-0.6	0.5	Pass
4th Qtr.2021	PSEG(PNNL) 200mR	-2.6	2.0	Pass
4th Qtr.2021	Seabrook	2.6	1.4	Pass

[(1)]Performance criteria are +/- 30%.
[(2)]Blind spike irradiations using Cs-137

SECTION 8.0

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8.0 REFERENCES

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