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BYRON NUCLEAR GENERATING STATION
UNITS 1 and 2

Annual Radiological
Environmental Operating Report

1 January Through 31 December 2019

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I. Summary and Conclusions

This report on the Radiological Environmental Monitoring Program conducted for the Byron Nuclear Generating Station by Exelon covers the period 1 January 2019 through 31 December 2019. During that time period, 1,427 analyses were performed on 1,267 samples. In assessing all the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of BNGS had no adverse radiological impact on the environment.

Surface water samples were analyzed for concentrations of gross beta, tritium, Nickel-63 (Ni-63), and gamma-emitting nuclides. Ground water samples were analyzed for concentrations of tritium and gamma-emitting nuclides. Gross beta activities detected were consistent with those detected in previous years. All surface water samples analyzed for Ni-63 were less than the minimum detectable concentration. Tritium detected in downstream surface water was well below reportable limits and consistent with expected levels as a result of permitted liquid discharges.

Fish (commercially and/or recreationally important species) and sediment samples were analyzed for concentrations of Ni-63 and gamma-emitting nuclides. Cesium-137 (Cs-137) was detected in 4 of 4 sediment samples with concentrations ranging from 139 - 242 pCi/kg. No other fission or activation products were detected.

Air particulate samples were analyzed for concentrations of gross beta and gamma-emitting nuclides. No fission or activation products were detected.

High sensitivity Iodine-131 (I-131) analyses were performed on weekly air samples. All results were less than the minimum detectable concentration for I-131.

Cow milk samples were analyzed for concentrations of I-131 and gamma- emitting nuclides. All I-131 results were below the minimum detectable activity. No fission or activation products were found.

Food Product samples were analyzed for concentrations of gamma-emitting nuclides. No fission or activation products were detected.

Environmental gamma radiation measurements were performed quarterly using Optically Stimulated Luminescence Dosimeters (OSLD). Beginning in 2012, Exelon changed the type of dosimetry used for the Radiological Environmental Monitoring Program (REMP). Optically Stimulated Luminescent Dosimetry were deployed and Thermoluminescent Dosimetry (TLD) were discontinued. This change may have resulted in a step change in readings, up or down, depending on site characteristics. The relative comparison to control locations remains valid. OSLD technology is different than that used in a TLD but has the same purpose (to measure direct radiation).

II. Introduction

Byron Station, a two-unit PWR station, is located about two miles east of the Rock River and approximately three miles southwest of Byron in Ogle County, Illinois. The reactors are designed to have capacities of 1,268 and 1,241 MW gross, respectively. Unit One loaded fuel in November 1984 and went on line February 2, 1985. Unit Two went on line January 9, 1987. The station has been designed to keep releases to the environment at levels below those specified in the codes of federal regulations.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Landauer on samples collected during the period 1 January 2019 through 31 December 2019.

A. Objectives of the REMP

The objectives of the REMP are to:

1. Provide data on measurable levels of radiation and radioactive materials in the site environs.

2. Evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure.

B. Implementation of the Objectives

The implementation of the objectives is accomplished by:

1. Identifying significant exposure pathways

2. Establishing baseline radiological data of media within those pathways

3. Continuously monitoring those media before and during Station operation to assess Station radiological effects (if any) on man and the environment

III. Program Description

A. Sample Collection

Samples for the BNGS REMP were collected for Exelon Nuclear by Environmental Inc. (Midwest Labs). This section describes the general collection methods used by Environmental Inc. to obtain environmental samples for the BNGS REMP in 2019. Sample locations and descriptions can be found in Table B–1 and Figures B–1 through B–5, Appendix B.

Aquatic Environment

The aquatic environment was evaluated by performing radiological analyses on samples of surface water, ground water, fish and sediment. Two gallon water samples were collected weekly from two surface water locations (BY-12 and BY-29 [Control location]) and quarterly from six ground water locations (BY-14-1, BY-18-1, BY-32, BY-35, BY-37 and BY-38). All samples were collected in new unused plastic bottles, which were rinsed with source water prior to collection. Fish samples comprising the flesh of silver redhorse, shorthead redhorse, freshwater drum, common carp and channel catfish were collected semiannually at two locations, BY-29 (control) and BY-31. Sediment samples composed of recently deposited substrate were collected at two locations semiannually, BY-12 and BY-34 (control).

Atmospheric Environment

The atmospheric environment was evaluated by performing radiological analyses on samples of air particulate, and airborne iodine. Airborne iodine and particulate samples were collected and analyzed weekly at eight locations (BY-01, BY-04, BY-06, BY-08, BY-21, BY-22, BY-23 and BY-24). The control location was BY-08. Airborne iodine and air particulate samples were obtained at each location, using a vacuum pump with charcoal and glass fiber filters attached. The pumps ran continuously and sampled air at the rate of approximately one cubic foot per minute. The air filters and air iodine samples were replaced weekly and sent to the laboratory for analysis.

Terrestrial Environment

The terrestrial environment was evaluated by performing radiological analyses on samples of milk and food products. Milk samples were collected monthly from January through April and November through December, and biweekly May through October. The control location was BY-26-2 and the indicator location was BY-20-1. All samples were collected in new unused two gallon plastic bottles from the bulk tank at each

location, preserved with sodium bisulfite and shipped promptly to the laboratory.

Food products were collected annually in August at five locations (BY-Control, BY-Quad 1, BY-Quad 2, BY-Quad 3 and BY-Quad 4). Various types of samples were collected and placed in new unused plastic bags, and sent to the laboratory for analysis.

Ambient Gamma Radiation

Beginning in 2012, Exelon changed the type of dosimetry used for the Radiological Environmental Monitoring Program (REMP). Optically Stimulated Luminescent Dosimetry (OSLD) were deployed and Thermoluminescent Dosimetry (TLD) were discontinued. This change may result in a step change in readings, up or down, depending on site characteristics. The relative comparison to control locations remains valid. OSLD technology is different than that used in a TLD but has the same purpose (to measure direct radiation).

In recent years, the industry recognized the need for a standard method of reporting environmental dosimetry results. In 2019, Exelon began assessing facility-related dose in accordance with ANSI N13.37-2014, Environmental Dosimetry – Criteria for System Design and Implementation. This standard is applicable to passive environmental dosimetry systems used to monitor areas surrounding radiological facilities to assess potential facility-related radiation doses and to verify compliance with public dose limits. Such environmental dosimetry systems include dosimeters which accumulate radiation dose and any readout device required to process the dosimeters. Passive dosimeters include optically stimulated luminescence (OSL) dosimeters which are deployed at field locations around a facility and exchanged periodically (e.g., quarterly). Facility-related dose is calculated using a statistical model that uses baseline historical data and accounts for transit and deploy dose. In 2019, none of the Byron Station field locations listed in this report exhibited facility-related dose as calculated in accordance with this standard.

Each location consisted of 2 OSLD sets. The OSLDs were exchanged quarterly and sent to Landauer for analysis. The OSLDs were placed at locations on and around the BNGS Station site as follows:

An inner ring consisting of 16 locations (BY-101, BY-102, BY-103, BY-104, BY-105, BY-106, BY-107, BY-108, BY-109, BY-110, BY-111, BY-112, BY-113, BY-114, BY-115 and BY-116) near and within the site perimeter representing fence post doses (i.e., at locations where the doses will be potentially greater than maximum annual off–site doses) from BNGS releases.

An outer ring consisting of 16 locations (BY-201, BY-202, BY-203, BY-204, BY-205, BY-206, BY-207, BY-208, BY-209, BY-210, BY-211, BY-212, BY-213, BY-214, BY-215 and BY-216) extending to approximately 5 miles from the site designed to measure possible exposures to close-in population.

A special interest set consisting of seven locations (BY-301-1, BY-301-2, BY-309-1, BY-309-2, BY-309-3, BY-309-4, and BY-314-2) to measure possible exposures from on-site storage facilities.

An other set consisting of seven locations (BY-01, BY-04, BY-06, BY-21, BY-22, BY-23 and BY-24) at locations where air samplers are present.

The balance of one location (BY-08) representing the control area.

The specific OSLD locations were determined by the following criteria:

1. The presence of relatively dense population;

2. Site meteorological data taking into account distance and elevation for each of the sixteen–22 1/2 degree sectors around the site, where estimated annual dose from BNGS, if any, would be most significant;

3. On hills free from local obstructions and within sight of the vents (where practical);

4. And near the closest dwelling to the vents in the prevailing downwind direction if applicable.

Two OSLDs were placed at each location above ground level. The OSLDs were exchanged quarterly and sent to Landauer for analysis.

B. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the BNGS REMP in 2019. The analytical procedures used by the laboratory are listed in Table B-2.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of beta emitters in surface water and air particulates

2. Concentrations of gamma emitters in ground and surface water, air particulates, milk, fish, sediment and vegetation

3. Concentrations of tritium in ground and surface water

4. Concentrations of Iodine-131 in air and milk

5. Concentrations of Nickel-63 in surface water, fish and sediment

6. Ambient gamma radiation levels at various site environs

C. Data Interpretation

The radiological and direct radiation data collected prior to Byron Nuclear Generating Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Byron Nuclear Generating Station was considered operational at initial criticality. In addition, data were compared to previous years' operational data for consistency and trending. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

The lower limit of detection (LLD) was defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD was intended as a before-the- fact estimate of a system (including instrumentation, procedure and sample type) and not as an after-the-fact criteria for the presence of activity. All analyses were designed to achieve the required BNGS detection capabilities for environmental sample analysis.

The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an after-the-fact estimate of the presence of activity.

2. Net Activity Calculation and Reporting of Results

Net activity for a sample was calculated by subtracting background activity from the sample activity. Since the REMP measures extremely small changes in radioactivity in the environment, background variations may result in sample activity being lower than the background activity, effecting a negative number. An MDC was reported in all cases where positive activity was not detected.

Gamma spectroscopy results for each type of sample were grouped as follows:

For surface water, ground water, milk and vegetation, twelve nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140 and La-140 were reported.

For fish, sediment, and air particulates, eleven nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, Cs-134, Cs-137, Ba-140 and La-140 were reported.

Means and standard deviations of the results were calculated. The standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

For 2019, the BNGS REMP had a sample recovery rate in excess of 99%. Sample anomalies and missed samples are listed in the tables below:

TABLE D-1 LISTING OF SAMPLE ANOMALIES

Sample Type	Location Code	Collection Date	Reason
AP	BY-01	01/29/19	Small part of filter damaged during handing
AP/AI	ALL	01/31/19	Rotameter arrived broken and could not be calibrated on due date; Spare #2 calibrated on 02/07/19 and sent as replacement
AP/AI	BY-24	04/23/19	Run time meter would not reset - replaced
OSLD	BY-105-2	04/01/19	Dosimeter missing during exchange
SED	BY-12 BY-24	05/31/19	Could not obtain sediment during May due to high river levels - sample obtained on 06/18/19
AP/AI	BY-23	06/11/19	Low timer reading due to power outage from raccoon contact
AP/AI	ALL	06/11/19	Possible low timer readings due to storms
OSLD	BY-103-3	09/03/19	TLD missing during monthly checks - replaced with spare 1 EX00059280W - replaced on 09/04/19
AP/AI	BY-08	09/17/19	No power to air sampler due to tripped breaker; restored power on 09/1/19
AP/AI	ALL	09/24/19	Pump field checks delayed one week for new collector's training; field checks performed on 10/0/19
AP/AI	BY-23	10/15/19	Air sampler flow rate 66 cfh; unable to adjust, pump replaced on 10/17/19 with #184
AP/AI	BY-23	10/22/19	Air sampler flow rate 70 cfh; pump adjusted to 60cfh

TABLE D-2 LISTING OF MISSED SAMPLES

Sample Type	Location Code	Collection Date	Reason
SW	BY-29	01/02/19	Sample unobtainable due to ice on river
SW	BY-12 BY-29	01/22/19	Sample unobtainable due to ice on river
SW	BY-12 BY-29	01/29/19	Sample unobtainable due to ice on river
SW	BY-29	02/05/19	Sample unobtainable due to ice on river
SW	BY-12 BY-29	02/11/19	Sample unobtainable due to ice on river
SW	BY-12 BY-29	02/19/19	Sample unobtainable due to ice on river
AP/AI	BY-21	02/19/19	Air sampler found damaged - no sample obtained; replaced on 02/20/19
SW	BY-12 BY-29	02/26/19	Sample unobtainable due to ice on river
SW	BY-12 BY-29	03/05/19	Sample unobtainable due to ice on river
AP/AI	BY-23	06/04/19	No power to the air sampler due to raccoon contact; no sample taken; no pp field check performed; repaired on 06/15/19

Each program exception was reviewed to understand the causes of the program exception. Sampling and maintenance errors were reviewed with the personnel involved to prevent recurrence. Occasional equipment breakdowns and power outages were unavoidable.

The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

E. Program Changes

There were no program changes in 2019.

IV. Results and Discussion

A. Aquatic Environment

1. Surface Water

Samples were taken weekly and composited monthly at two locations (BY-12 and BY-29). Of these locations only BY-12 located downstream, could be affected by Byron Nuclear Generating Station's effluent releases. The following analyses were performed:

Gross Beta

Samples from both locations were analyzed for concentrations of gross beta (Table C–I.1, Appendix C). The values ranged from 2.8 to 6.4 pCi/L. Concentrations detected were consistent with those detected in previous years (Figure C–1, Appendix C).

Tritium

Quarterly composites of weekly collections were analyzed for tritium activity (Table C–I.2, Appendix C). Tritium was detected in one sample at a concentration of 828 pCi/L (Figure C–2, Appendix C). Tritium detected in downstream surface water was well below reportable limits and consistent with expected levels as a result of permitted liquid discharges.

Nickel

Samples from both locations were analyzed for concentration of Ni-63 (Table C–I.3, Appendix C). All results were less than the minimum detectable concentration.

Gamma Spectrometry

Samples from both locations were analyzed for gamma-emitting nuclides (Table C–I.4, Appendix C). No nuclides were detected, and all required LLDs were met.

2. Ground Water

Quarterly grab samples were collected at six locations (BY-14-1, BY-18-1, BY-32, BY-35, BY-37 and BY-38). These locations could be affected by Byron Nuclear Generating Station's effluent releases. The following analyses were performed:

Tritium

Quarterly grab samples from the locations were analyzed for tritium activity (Table C–II.1, Appendix C). No tritium was detected, and the required LLD was met (Figures C–3 through C–7, Appendix C).

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Table C–II.2 Appendix C). No nuclides were detected, and all required LLDs were met.

3. Fish

Fish samples comprised of silver redhorse, shorthead redhorse, freshwater drum, common carp and channel catfish were collected at two locations (BY-29 and BY-31) semiannually. Location BY-31 could be affected by Byron Nuclear Generating Station's effluent releases. The following analyses were performed:

Nickel

The edible portion of fish samples from both locations was analyzed for Ni-63 (Table C–III.1, Appendix C). Nickel-63 was not detected and the required LLD was met.

Gamma Spectrometry

The edible portion of fish samples from both locations was analyzed for gamma-emitting nuclides (Table C–III.1, Appendix C). No nuclides were detected, and all required LLDs were met.

4. Sediment

Aquatic sediment samples were collected at two locations (BY-12 and BY-34) semiannually. BY-12, located downstream, could be affected by Byron Nuclear Generating Station's effluent releases. The following analyses were performed:

Nickel

Sediment samples from both locations were analyzed for Ni-63 (Table C–IV.1, Appendix C). Ni-63 was not detected and the required LLD was met.

Gamma Spectrometry

Sediment samples from both locations were analyzed for gamma-emitting nuclides (Table C–IV.1, Appendix C). Cesium-137 was detected in all samples. The concentrations ranged from 139 - 242 pCi/kg. No other nuclides were detected, and all required LLDs were met.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from eight locations on a weekly basis. The eight locations were separated into three groups: Nearsite samplers within 4 km of the site (BY-21, BY-22, BY-23 and BY-24), Far Field samplers between 4 and 10 km of the site (BY-01, BY-04 and BY-06) and the Control sampler between 10 and 30 km from the site (BY-08). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Table C–V.1 and C–V.2, Appendix C). Detectable gross beta activity was observed at all locations. Comparison of results among the three groups aid in determining the effects, if any, resulting from the operation of BNGS.

The results from the Nearsite locations (Group I) ranged from 4 to 32E–3 pCi/m^3 with a mean of 15E–3 pCi/m^3. The results from the Far Field locations (Group II) ranged from 5 to 33E–3 pCi/m^3 with a mean of 15E–3 pCi/m^3. The results from the Control location (Group III) ranged from 6 to 33E–3 pCi/m^3 with a mean of 15E–3 pCi/m^3. Comparison of the 2019 air particulate data with previous year's data indicate no effects from the operation of BNGS. In addition, a comparison of the weekly mean values for 2019 indicate no notable differences among the three groups (Figures C–8 through C-12, Appendix C).

Gamma Spectrometry

Weekly samples were composited quarterly and analyzed for gamma-emitting nuclides (Table C–V.3, Appendix C). No nuclides were detected, and all required LLDs were met.

b. Airborne Iodine

Continuous air samples were collected from eight locations (BY-01, BY-04, BY-06, BY-08, BY-21, BY-22, BY-23 and BY-24) and analyzed weekly for I-131 (Table C–VI.1, Appendix C). All results were less than the minimum detectable concentration for I-131.

2. Terrestrial

a. Milk

Samples were collected from two locations (BY-20-1 and BY-26-2) monthly from January to April and November through December, and biweekly May through October. The following analyses were performed:

Iodine-131

Milk samples from all locations were analyzed for concentrations of I-131 (Table C–VII.1, Appendix C). No nuclides were detected, and all required LLDs were met.

Gamma Spectrometry

Each milk sample was analyzed for concentrations of gamma-emitting nuclides (Table C–VII.2, Appendix C). No nuclides were detected, and all required LLDs were met.

b. Vegetation

Vegetation samples were collected at five locations (BY-Control, BY-Quad 1, BY-Quad 2, BY-Quad 3 and BY-Quad 4). Four locations (BY-Quad 1, BY-Quad 2, BY-Quad 3 and BY-Quad 4) could be affected by Byron Nuclear Generating Station's effluent releases. The following analysis was performed:

Gamma Spectrometry

Samples from all locations were analyzed for gamma- emitting nuclides (Table C–VIII.1, Appendix C). No nuclides were detected, and all required LLDs were met.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing OSLDs. Ninety-one OSLD locations were established around the site. Results of OSLD measurements are listed in Tables C–IX.1 to C–IX.3, Appendix C.

All OSLD measurements were below 26 mR/standard quarter, with a range of 12 to 25 mR/standard quarter. A comparison of the Inner Ring, Outer Ring, Special Interest, Other and Control Location data indicate that the ambient gamma radiation levels were comparable among the groups.

D. Land Use Survey

A Land Use Survey conducted during August, 2019 around the Byron Nuclear Generating Station (BNGS) was performed by Environmental Inc. (Midwest Labs) for Exelon Nuclear to comply with the Byron Nuclear Generating Station's Offsite Dose Calculation Manual. The purpose of the survey was to document the nearest resident, livestock, and milk producing animals in each of the sixteen 22 ½ degree sectors. The results of this survey are summarized below:

Distance in Miles from the BNGS Vent Stacks				
Sector		Residence Miles	Livestock Miles	Milk Farm Miles
A	N	1.2	5.9	-
B	NNE	1.6	6.2	-
C	NE	1.1	2.0	-
D	ENE	1.4	3.7	-
E	E	1.0	4.2	-
F	ESE	1.5	1.5	-
G	SE	1.7	3.5	-
H	SSE	0.7	3.3	-
J	S	0.6	0.7	-
K	SSW	0.7	0.7	-
L	SW	0.8	2.0	-
M	WSW[(a)]	1.6	0.8	4.5
N	W	1.8	3.2	-
P	WNW	1.6	1.6	11.5
Q	NW	0.8	1.5	-
R	NNW	0.9	1.4	-

(a) *Denotes the nearest industrial facility located at 1.5 miles*

E. Errata Data

The 2018 AREOR contained a typographical error in Table D-2 Listing of Missed Samples. (See Appendix G)

F. Summary of Results – Inter-Laboratory Comparison Program

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine (charcoal), milk, soil, vegetation and water (including fish) matrices (Appendix D). The PE sample matrices were chosen based

on the types of samples submitted to the primary laboratory for analysis. The selected parameters for the PE samples are based on the appropriate matrices, methodologies and geometries, which include geometries that are comparable. The PE samples, supplied by Analytics Inc., Environmental Resource Associates (ERA) and DOE's Mixed Analyte Performance Program (MAPEP) were evaluated against the following pre-set acceptance criteria:

1. Analytics Evaluation Criteria

   Analytics' evaluation report provides a ratio of laboratory results and Analytics' known value. Since flag values are not assigned by Analytics, TBE-ES evaluates the reported ratios based on internal QC requirements, which are based on the DOE MAPEP criteria.

2. ERA Evaluation Criteria

   ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the USEPA, NELAC, state specific PT program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

3. DOE Evaluation Criteria

   MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

   - Acceptable (flag = "A") - result within ± 20% of the reference value
   - Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
   - Not Acceptable (flag = "N") - bias is greater than 30% of the reference value

   Note: The Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

For the TBE laboratory, 119 out of 129 analyses performed met the specified acceptance criteria. Ten analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program. A summary is found below:

1. The ERA April 2019 water Cs-134 result was evaluated as *Not Acceptable*. The reported value was 15.2 pCi/L (error 2.82 pCi/L) and the known result was 12.1 pCi/L (acceptance range of 8.39 - 14.4 pCi/L). With the error, the reported result overlaps the acceptable range. This sample was run as the workgroup duplicate on a different detector with a result of 10.7 pCi/L (within acceptable range). (NCR 19-10)

2. The ERA April 2019 water Sr-89 result was evaluated as *Not Acceptable*. The reported value was 44.9 pCi/L and the known result was 33.3 pCi/L (acceptance range of 24.5 - 40.1 pCi/L). The sample was only counted for 15 minutes instead of 200 minutes. The sample was re-prepped in duplicate and counted for 200 minutes with results of 30.7 ± 5.37 pCi/L and 33.0 ± 8.71 pCi/L. This was the 1st "high" failure for Sr-89 in 5 years. (NCR 19-11)

3. The MAPEP February 2019 soil Sr-90 result was not submitted and therefore evaluated as *Not Acceptable*. The sample was run in duplicate, with results of -1.32 ± 4.09 Bq/kg (<6.87) and -1.030 ± 3.55 Bq/kg (<5.97). The known result was a false positive test (no significant activity). TBE did not submit a result because it appeared that the results may not be accurate. TBE analyzed a substitute soil Sr-90 sample from another vendor, with a result within the acceptable range. (NCR 19-12)

4. The MAPEP February 2019 water Am-241 result was evaluated as *Not Acceptable*. The reported value was 0.764 ± 0.00725 Bq/L with a known result of 0.582 Bq/L (acceptable range 0.407 - 0.757 Bq/L). TBE's result falls within the upper acceptable range with the error. It appeared that a non-radiological interference was added and lead to an increased mass and higher result. (NCR 19-13)

5. The MAPEP February 2019 vegetation Sr-90 result was evaluated as *Not Acceptable*. The reported result was -0.1060 ± 0.0328 Bq/kg and the known result was a false positive test (no significant activity). TBE's result was correct in that there was no activity. MAPEP's evaluation was a "statistical failure" at 3 standard deviations. (NCR 19-14)

6. The ERA October 2019 water Gross Alpha result was evaluated as *Not Acceptable*. TBE's reported result was 40.5 ± 10.3 pCi/L and the known result was 27.6 pCi/L (ratio of TBE to known result at 135%). With the associated error, the result falls within the acceptable range (14.0 - 36.3 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 30.8 ± 9.17 pCi/L (within the acceptable range). This was the first failure for drinking water Gr-A

since 2012. (NCR 19-23)

7. The ERA October 2019 water Sr-90 result was evaluated as *Not Acceptable*. TBE's reported result was 32.5 ± 2.12 pCi/L and the known result was 26.5 pCi/L (ratio of TBE to known result at 123%). With the associated error, the result falls within the acceptable range (19.2 - 30.9 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 20.0 ± 1.91 pCi/L (within the acceptable range). Both TBE results are within internal QC limits. A substitute "quick response" sample was analyzed with an acceptable result of 18.6 pCi/L (known range of 13.2 - 22.1 pCi/L). (NCR 19-24)

8. The MAPEP August 2019 soil Ni-63 result of 436 ± 22.8 Bq/kg was evaluated as Not Acceptable. The known result was 629 Bq/kg (acceptable range 440 - 818 Bq/sample). With the associated error, the TBE result falls within the lower acceptance range. All associated QC was acceptable. No reason for failure could be found. This is the first failure for soil Ni-63 since 2012. (NCR 19-25).

9. The MAPEP August 2019 water Am-241 result was not reported and therefore evaluated as *Not Acceptable*. Initial review of the results showed a large peak where Am-241 should be (same as the February, 2019 sample results). It is believed that Th-228 was intentionally added as an interference. The sample was re-prepped and analyzed using a smaller sample aliquot. The unusual large peak (Th-228) was seen again and also this time a smaller peak (Am-241). The result was 436 ± 22.8 Bq/L (acceptable range 0.365 ± 0.679 Bq/L). Th-228 is not a typical nuclide requested by clients, so there is no analytical purpose to take samples through an additional separation step. TBE will pursue using another vendor for Am-241 water cross-checks that more closely reflects actual customer samples. (NCR 19-26)

10. The Analytics September 2019 soil Cr-51 sample was evaluated as *Not Acceptable*. TBE's reported result of 0.765 ± 0.135 pCi/g exceeded the upper acceptance range (140% of the known result of 0.547 pCi/g). The TBE result was within the acceptable range (0.63 - 0.90 pCi/g) with the associated error. The Cr-51 result is very close to TBE's normal detection limit. In order to get a reportable result, the sample must be counted for 15 hours (10x longer than client samples). There is no client or regulatory requirement for this nuclide and TBE will remove Cr-51 from the reported gamma nuclides going forward. (NCR 19-27)

The Inter-Laboratory Comparison Program provides evidence of "in control" counting systems and methods, and that the laboratories are producing accurate and reliable data.

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

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TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR BYRON NUCLEAR GENERATING STATION, 2019

NAME OF FACILITY: BYRON NUCLEAR GENERATING STATION | **DOCKET NUMBER:** 50-454 & 50-455

LOCATION OF FACILITY: BYRON, IL | **REPORTING PERIOD:** 2019

MEDIUM OR PATHWAY SAMPLED (Uint of Measurement)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER (PCI/LITER)	**GR-B**	23	4	4.4 (9/12) 2.8 - 6.4	4.3 (9/11) 2.9 - 5.8	4.4 (9/12) 2.8 - 6.4	BY-12 INDICATOR OREGON POOL OF ROCK RIVER - DOWNSTREAM 4.5 MILES SSW OF SITE	0
	H-3	8	200	828 (1/4)	<LLD	828 (1/4)	BY-12 INDICATOR OREGON POOL OF ROCK RIVER - DOWNSTREAM 4.5 MILES SSW OF SITE	0
	NI-63	23	30	<LLD	<LLD	-		0
	GAMMA	23						
	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
	I-131		15	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0
GROUND WATER (PCI/LITER)	**H-3**	24	200	<LLD	NA	-		0
	GAMMA	24						
	MN-54		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
	CS-137		18	<LLD	NA	-		0
	BA-140		60	<LLD	NA	-		0
	LA-140		15	<LLD	NA	-		0
FISH (PCI/LITER)	**NI-63**	8	260	<LLD	<LLD	-		0

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR BYRON NUCLEAR GENERATING STATION, 2019

NAME OF FACILITY:	**BYRON NUCLEAR GENERATING STATION**				**DOCKET NUMBER:**	**50-454 & 50-455**		
LOCATION OF FACILITY:	**BYRON, IL**				**REPORTING PERIOD:**	**2019**		
MEDIUM OR PATHWAY SAMPLED *(Uint of Measurement)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
FISH	**GAMMA**	8						
(PCI/KG WET)	*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
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		**130**	<LLD	<LLD	-		0
	CS-137		**150**	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
SEDIMENT	**NI-63**	4	**260**	<LLD	<LLD	-		0
(PCI/KG DRY)								
	GAMMA	4				-		
	MN-54		*NA*	<LLD	<LLD			0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		**150**	<LLD	<LLD	-		0
	CS-137		**180**	154 (2/2) *139 - 170*	217 (2/2) *192 - 242*	217 (2/2) *192 - 242*	BY-34 CONTROL ROCK RIVER UPSTREAM OF DISCHARGE 2.6 MILES WNW OF SITE	0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
AIR PARTICULATE	**GR-B**	414	**10**	15 (361/362) *4 - 33*	15 (52/52) *6 - 33*	16 (51/51) *5 - 32*	BY-21 INDICATOR BYRON NEARSITE NORTH 0.3 MILES N OF SITE	0
(E-3 PCI/CU.METER)								
	GAMMA	32						
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR BYRON NUCLEAR GENERATING STATION, 2019

NAME OF FACILITY:	**BYRON NUCLEAR GENERATING STATION**				**DOCKET NUMBER:**	**50-454 & 50-455**		
LOCATION OF FACILITY:	**BYRON, IL**				**REPORTING PERIOD:**	**2019**		
MEDIUM OR PATHWAY SAMPLED *(Uint of Measurement)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR IODINE	**GAMMA**	414						
(E-3 PCI/CU.METER)	*I-131 (GELI)*		**70**	<LLD	<LLD	-		0
MILK	**I-131 (LOW LVL)**	38	**1**	<LLD	<LLD	-		0
(PCI/LITER)								
	GAMMA							
	MN-54	38	*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		**60**	<LLD	<LLD	-		0
	LA-140		**15**	<LLD	<LLD	-		0
VEGETATION	**GAMMA**	10						
(PCI/KG WET)	*MN-54*		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	I-131		**60**	<LLD	<LLD	-		0
	CS-134		**60**	<LLD	<LLD	-		0
	CS-137		**80**	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		
DIRECT RADIATION	**OSLD-QUARTERLY**	332	*NA*	20	17	23	BY-212-1 INDICATOR	0
(MILLIREM/QTR.)				(328/328)	(4/4)	(4/4)		
				12 - 25	*13 - 18*	*20 - 24*	4.7 MILES WSW	

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

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APPENDIX B

LOCATION DESIGNATION, DISTANCE & DIRECTION, AND SAMPLE COLLECTION & ANALYTICAL METHODS

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TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Byron Nuclear Generating Station, 2019

Location	Location Description	Distance & Direction From Site
A. Surface Water		
BY-12	Oregon Pool of Rock River, Downstream	4.5 miles SSW
BY-29	Byron, Upstream (control)	3.0 miles N
B. Ground/Well Water		
BY-14-1	3200 North German Church Road	1.0 miles SSE
BY-18-1	Calhoun	0.7 miles SSW
BY-32	Krueger Well	1.9 miles W
BY-35	Vancko Well	1.9 miles WNW
BY-37	Cavage Well	2.0 miles WNW
BY-38	Steve Storz Well	2.0 miles WNW
C. Milk		
BY-20-1	Ron Snodgrass Farm	4.8 miles WSW
BY-26-2	Joseph Akins Farm (control)	12.2 miles WNW
D. Air Particulates / Air Iodine		
BY-01	Byron	3.0 miles N
BY-04	Paynes Point	5.0 miles SE
BY-06	Oregon	4.7 miles SSW
BY-08	Leaf River (control)	7.0 miles WNW
BY-21	Byron Nearsite North	0.3 miles N
BY-22	Byron Nearsite Southeast	0.4 miles SE
BY-23	Byron Nearsite South	0.6 miles S
BY-24	Byron Nearsite Southwest	0.7 miles SW
E. Fish		
BY-29	Byron, Upstream (control)	3.0 miles N
BY-31	Byron, Discharge	2.6 miles WNW
F. Sediment		
BY-12	Oregon Pool of Rock River, Downstream	4.6 miles SSW
BY-34	Rock River, Upstream of Discharge (control)	2.6 miles WNW
G. Vegetation		
Quadrant 1	3989 Cox Road, Stillman Valley	4.8 miles E
Quadrant 2	6402 Brick Road, Oregon	4.8 miles SE
Quadrant 3	2002 Deer Path Road, Byron	1.0 miles SW
Quadrant 4	6315 River Rd., Byron	2.3 miles SW
Control	1725 Michigan Ave., Rockford	14.7 miles NNE
H. Environmental Dosimetry - OSLD		
Inner Ring		
BY-101-1 and -2		0.3 miles N
BY-102-1		1.0 miles NNE
BY-102-2		1.0 miles NNE

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Byron Nuclear Generating Station, 2019

Location	Location Description	Distance & Direction From Site
H. Environmental Dosimetry – OSLD (continued)		
Inner Ring		
BY-103-1 and -2		1.7 miles NE
BY-103-3		0.4 miles NE
BY-104-1 and -2		1.4 miles ENE
BY-104-3		0.3 miles ENE
BY-105-1 and -2		1.3 miles E
BY-106-1 and -2		1.4 miles ESE
BY-107-1 and -2		1.4 miles SE
BY-107-3		0.4 miles SE
BY-108-1		0.7 miles SSE
BY-108-2		0.6 miles SSE
BY-109-1 and -2		0.6 miles S
BY-110-1 and -2		0.7 miles SSW
BY-111-3		0.8 miles SW
BY-111-4		0.9 miles SW
BY-112-3 and -4		0.8 miles WSW
BY-113-1 and -2		0.7 miles W
BY-114-1 and -2		0.8 miles WNW
BY-115-1 and -2		1.0 miles NW
BY-116-1 and -2		1.4 miles NNW
BY-116-3		0.9 miles NNW
Outer Ring		
BY-201-3		4.4 miles N
BY-201-4		4.4 miles N
BY-202-1		4.4 miles NNE
BY-202-2		4.8 miles NNE
BY-203-1		4.8 miles NE
BY-203-2		4.7 miles NE
BY-204-1		4.1 miles ENE
BY-204-2		4.0 miles ENE
BY-205-1 and -2		3.8 miles E
BY-206-1		4.0 miles ESE
BY-206-2		4.3 miles ESE
BY-207-1		4.2 miles SE
BY-207-2		3.9 miles SE
BY-208-1		4.0 miles SSE
BY-208-2		3.8 miles SSE
BY-209-1 and -4		4.0 miles S
BY-210-3 and -4		3.9 miles SSW
BY-211-1 and -4		4.9 miles SW
BY-212-1 and -4		4.7 miles WSW
BY-213-1		4.7 miles W
BY-213-4		4.7 miles W
BY-214-1		4.7 miles WNW
BY-214-4		4.6 miles WNW
BY-215-1		4.2 miles NW
BY-215-4		4.2 miles NW
BY-216-1		4.5 miles NNW
BY-216-2		4.7 miles NNW

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Byron Nuclear Generating Station, 2019

Location	Location Description	Distance & Direction From Site
Special Interest		
BY-301-1		0.3 miles N
BY-301-2		0.2 miles N
BY-309-1		0.3 miles S
BY-309-2		0.4 miles S
BY-309-3		0.4 miles S
BY-309-4		0.4 miles SSW
BY-314-2		0.3 miles WNW
Other		
BY-01-1 and -2		3.0 miles N
BY-04-1 and -2		5.0 miles SE
BY-06-1 and -2		4.7 miles SSW
BY-21-1 and -2		0.3 miles N
BY-22-1 and -2		0.4 miles SE
BY-23-1 and -2		0.6 miles S
BY-24-1 and -2		0.7 miles SW
Control		
BY-08-1 and -2		7.0 miles WNW

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Byron Nuclear Generating Station, 2019

Sample Medium	Analysis	Sampling Method	Analytical Procedure Number
Surface Water	Gamma Spectroscopy	Monthly composite from weekly grab samples.	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Surface Water	Gross Beta	Monthly composite from weekly grab samples.	TBE, TBE-2008 Gross Alpha and/or Gross Beta Activity in Various Matrices
Surface Water	Nickel-63	Monthly composite from weekly grab samples.	TBE, TBE-2013 Radionickel Activity in Various Matrices
Surface Water	Tritium	Quarterly composite from weekly grab samples.	TBE, TBE-2011 Tritium Analysis in Drinking Water by Liquid Scintillation
Ground Water	Gamma Spectroscopy	Quarterly grab samples.	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Ground Water	Tritium	Quarterly grab samples.	TBE, TBE-2011 Tritium Analysis in Drinking Water by Liquid Scintillation
Fish	Gamma Spectroscopy	Semi-annual samples collected via electroshocking or other techniques	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Fish	Nickel-63	Semi-annual samples collected via electroshocking or other techniques	TBE, TBE-2013 Radionickel Activity in Various Matrices
Sediment	Gamma Spectroscopy	Semi-annual grab samples	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Sediment	Nickel-63	Semi-annual grab samples	TBE, TBE-2013 Radionickel Activity in Various Matrices
Air Particulates	Gross Beta	One-week composite of continuous air sampling through glass fiber filter paper	TBE, TBE-2008 Gross Alpha and/or Gross Beta Activity in Various Matrices
Air Particulates	Gamma Spectroscopy	Quarterly composite of continuous air sapling through glass fiber filter paper	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Air Iodine	Gamma Spectroscopy	One-week composite of continuous air sampling through charcoal filter	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Milk	I-131	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE, TBE-2012 Radioiodine in Various Matrices
Milk	Gamma Spectroscopy	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
Vegetation	Gamma Spectroscopy	Annual grab samples.	TBE, TBE-2007 Gamma-Emitting Radioisotope Analysis
OSLD	Optically Stimulated Luminescence Dosimetry	Quarterly OSLDs comprised of two Al_2O_3:C Landauer Incorporated elements.	Landauer Incorporated

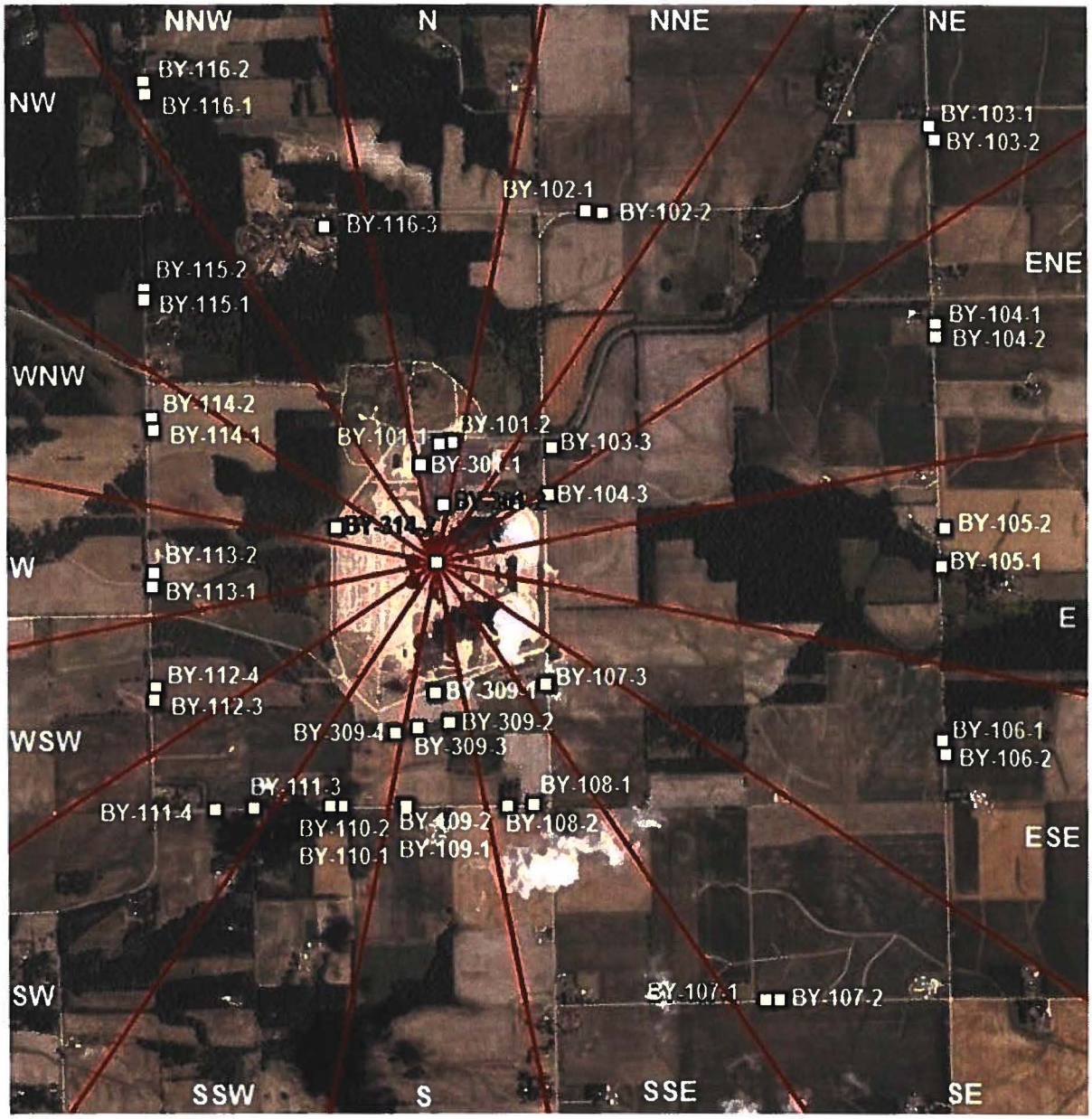


Figure B-1
Inner Ring and Special Interest OSLD Locations of the
Byron Nuclear Generating Station, 2019

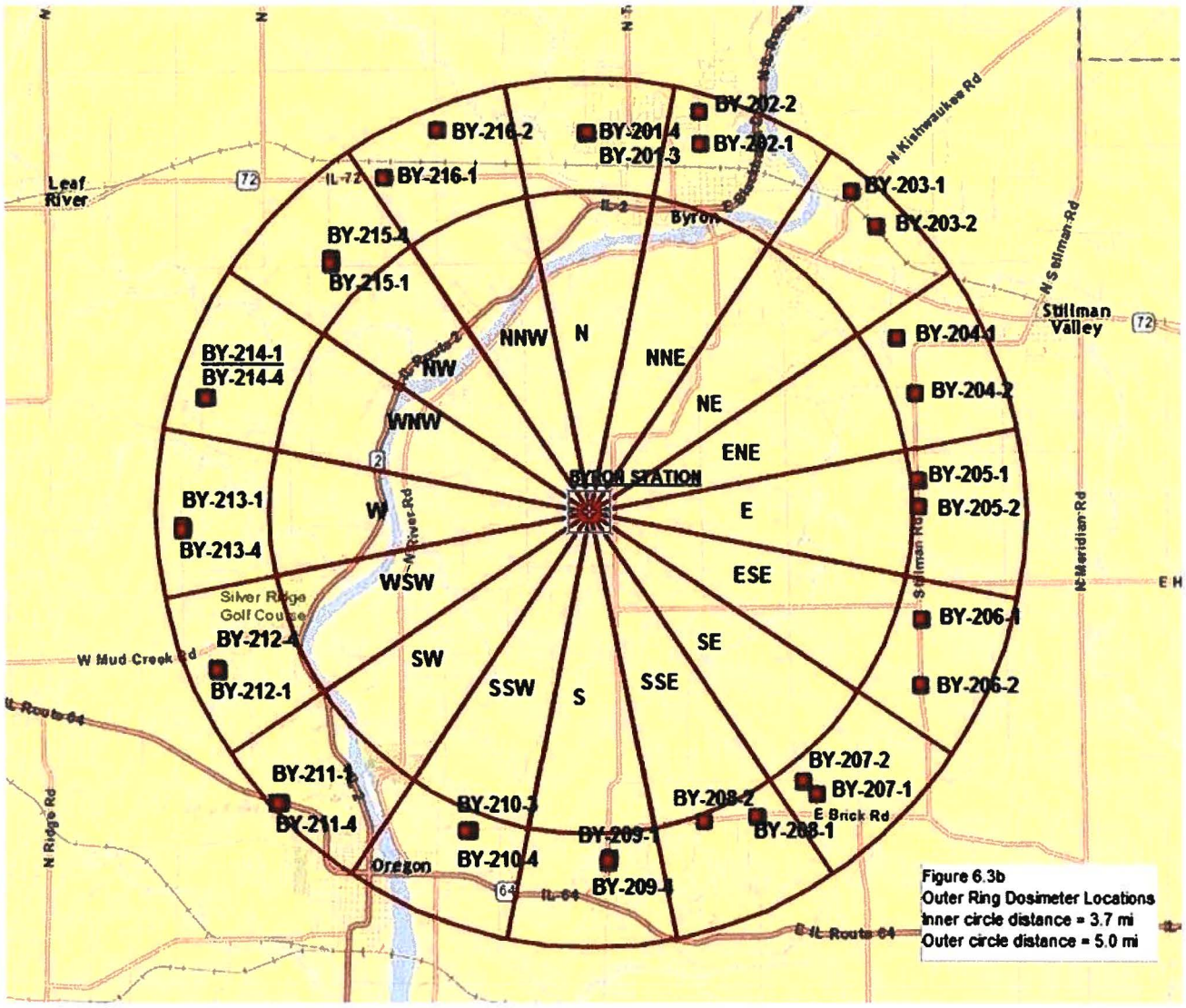


Figure B-2
Outer Ring OSLD Locations of the
Byron Nuclear Generating Station, 2019

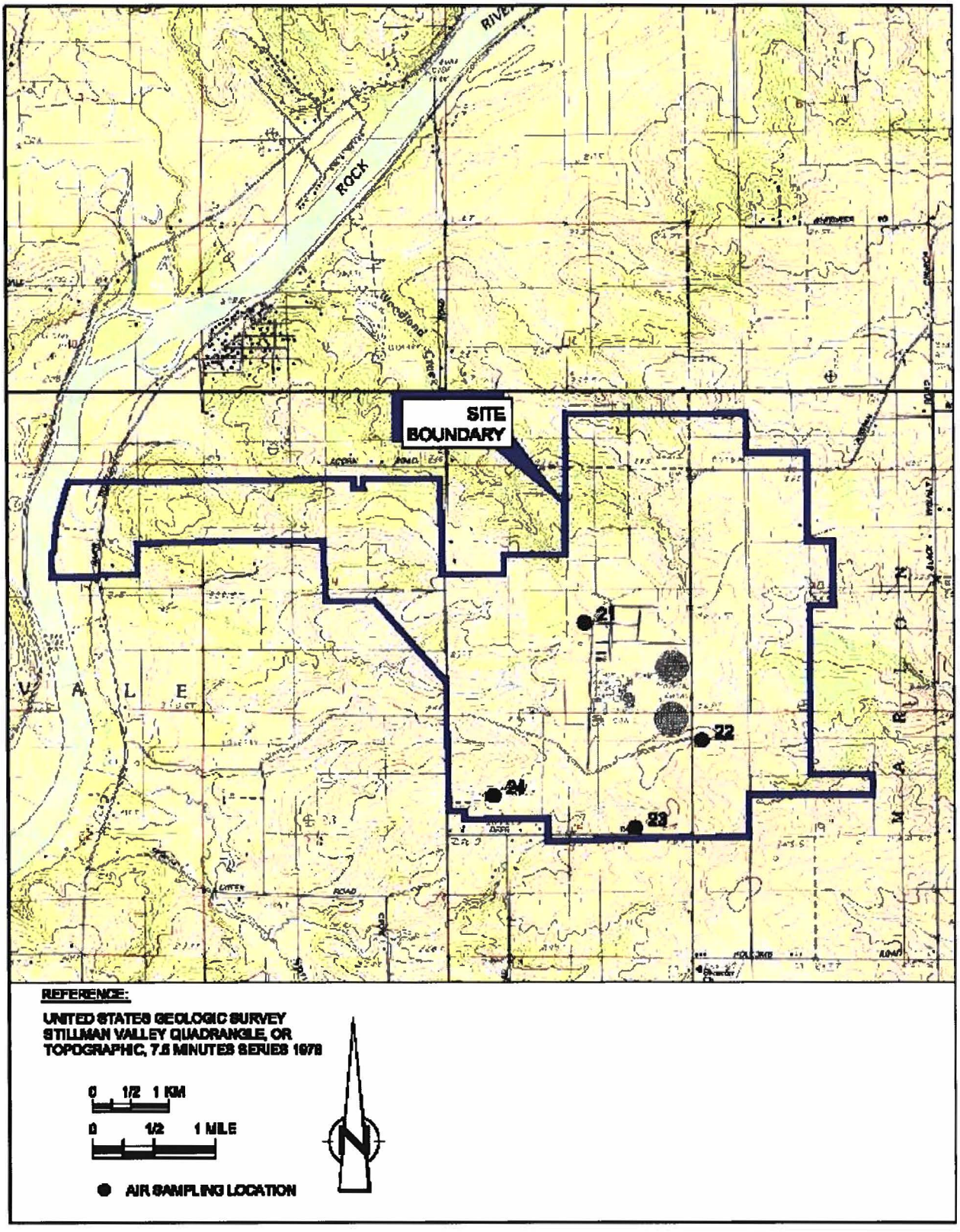
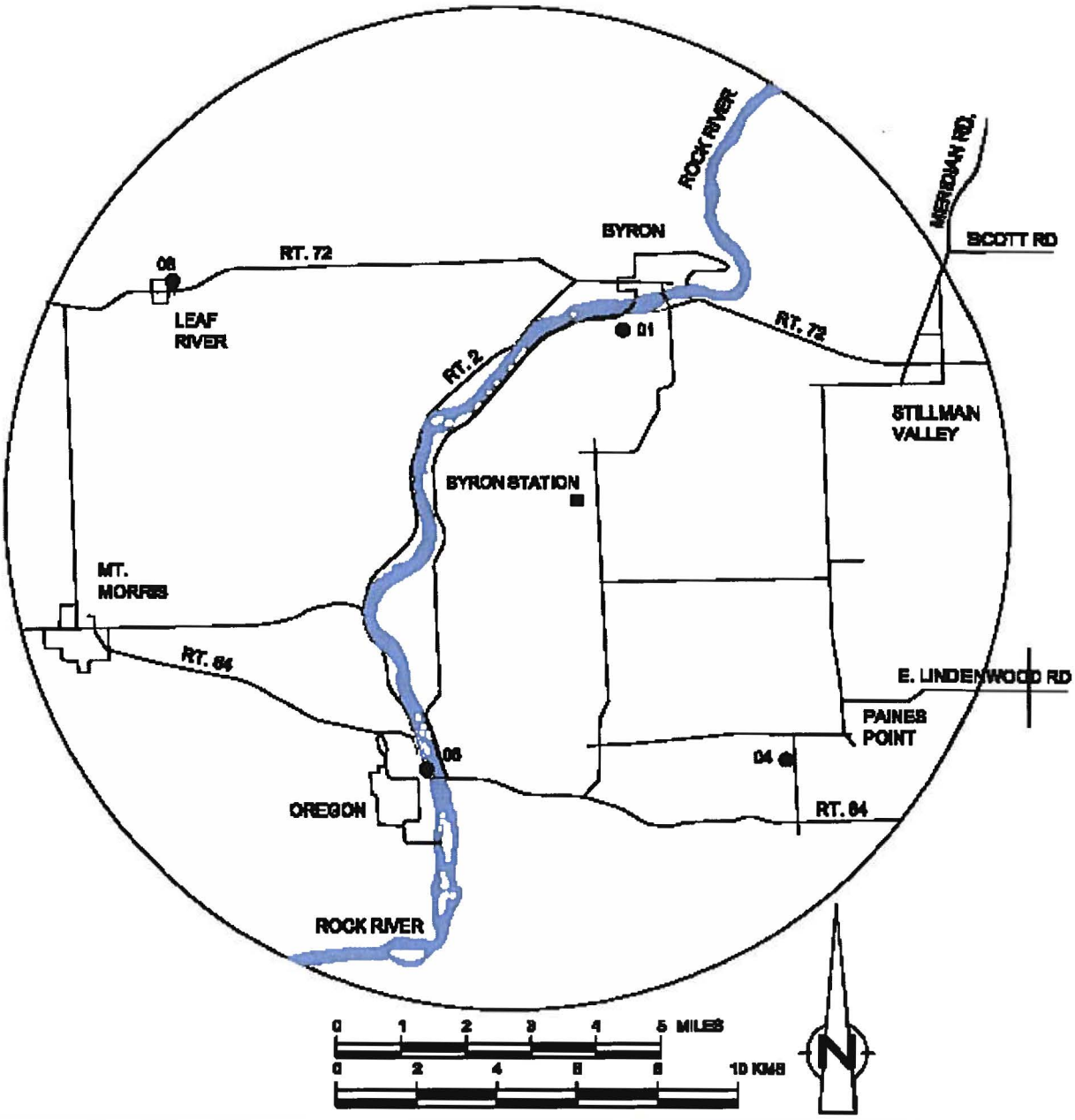


Figure B-3
Onsite Air Sampling Locations of the
Byron Nuclear Generating Station, 2019



- Air Sampling Location
- Byron Station

Figure B-4
Offsite Air Sampling Locations of the
Byron Nuclear Generating Station, 2019

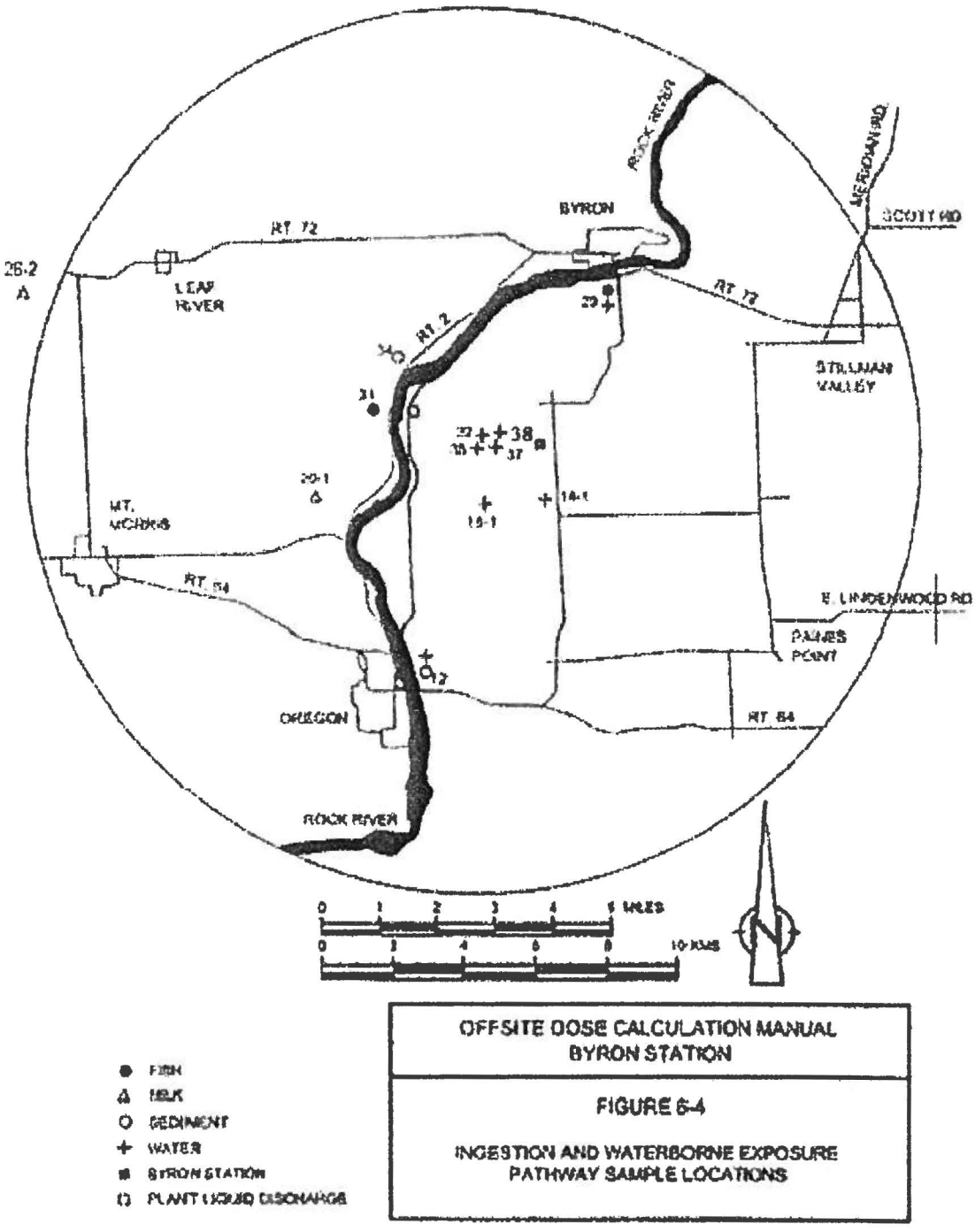


Figure B-5
Ingestion and Waterborne Exposure Pathway Sampling Locations
of the Byron Nuclear Generating Station, 2019

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APPENDIX C

DATA TABLES AND FIGURES

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Table C-I.1 **CONCENTRATIONS OF GROSS BETA IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	BY-12	BY-29
01/08/19 - 01/15/19	< 3.0	< 3.0
02/05/19 - 02/05/19	< 2.8	*(1)*
03/12/19 - 03/26/19	4.2 ± 1.7	5.4 ± 1.8
04/02/19 - 04/30/19	3.0 ± 2.0	2.9 ± 2.0
05/07/19 - 05/28/19	3.5 ± 2.0	4.0 ± 2.0
06/04/19 - 06/24/19	< 2.8	< 2.9
07/02/19 - 07/30/19	5.7 ± 2.8	3.7 ± 2.5
08/06/19 - 08/27/19	4.1 ± 1.9	5.1 ± 2.1
09/03/19 - 09/24/19	5.6 ± 2.0	3.5 ± 1.8
10/01/19 - 10/29/19	6.4 ± 2.1	5.8 ± 2.1
11/05/19 - 11/26/19	4.2 ± 2.0	4.5 ± 2.0
12/03/19 - 12/30/19	2.8 ± 1.8	4.1 ± 1.9
MEAN ± 2 STD DEV	4.4 ± 2.5	4.3 ± 1.9

Table C-I.2 **CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	BY-12	BY-29
01/08/19 - 03/26/19	< 193	< 198
04/02/19 - 06/24/19	< 187	< 186
07/02/19 - 09/24/19	< 183	< 182
10/01/19 - 12/30/19	828 ± 158	< 185
MEAN ± 2 STD DEV	828 ± 0	-

Table C-I.3 **CONCENTRATIONS OF NI-63 IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	BY-12	BY-29
01/08/19 - 01/15/19	< 21	< 21
02/05/19 - 02/05/19	< 5	*(1)*
03/12/19 - 03/26/19	< 25	< 22
04/02/19 - 04/30/19	< 16	< 16
05/07/19 - 05/28/19	< 20	< 23
06/04/19 - 06/24/19	< 16	< 15
07/02/19 - 07/30/19	< 17	< 17
08/06/19 - 08/27/19	< 18	< 19
09/03/19 - 09/24/19	< 18	< 18
10/01/19 - 10/29/19	< 27	< 16
11/05/19 - 11/26/19	< 17	< 19
12/03/19 - 12/30/19	< 25	< 28
MEAN	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-I.4

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
BY-12	01/02/19 - 01/15/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 13	< 2	< 2	< 27	< 9
	02/05/19 - 02/05/19	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 9	< 1	< 1	< 14	< 4
	03/12/19 - 03/26/19	< 3	< 3	< 6	< 3	< 6	< 3	< 5	< 10	< 3	< 3	< 20	< 5
	04/02/19 - 04/30/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 16	< 5
	05/07/19 - 05/28/19	< 1	< 2	< 4	< 2	< 3	< 2	< 3	< 9	< 2	< 2	< 16	< 5
	06/04/19 - 06/24/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 19	< 6
	07/02/19 - 07/30/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 19	< 7
	08/06/19 - 08/27/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 20	< 6
	09/03/19 - 09/24/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 15	< 6
	10/01/19 - 10/29/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 15	< 5
	11/05/19 - 11/26/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 9	< 2	< 2	< 17	< 5
	12/03/19 - 12/30/19	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 10	< 2	< 2	< 17	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-29	01/08/19 - 01/15/19	< 3	< 3	< 8	< 3	< 6	< 4	< 6	< 9	< 3	< 3	< 37	< 11
	02/05/19 - 02/05/19 (1)												
	03/12/19 - 03/26/19	< 2	< 2	< 6	< 3	< 5	< 3	< 5	< 8	< 3	< 3	< 18	< 6
	04/02/19 - 04/30/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 17	< 5
	05/07/19 - 05/28/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 12	< 2	< 2	< 19	< 7
	06/04/19 - 06/24/19	< 2	< 2	< 4	< 1	< 3	< 2	< 3	< 7	< 2	< 2	< 14	< 5
	07/02/19 - 07/30/19	< 2	< 3	< 6	< 2	< 4	< 3	< 4	< 14	< 2	< 2	< 23	< 7
	08/06/19 - 08/27/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 17	< 5
	09/03/19 - 09/24/19	< 2	< 2	< 4	< 2	< 4	< 2	< 3	< 7	< 2	< 2	< 14	< 5
	10/01/19 - 10/29/19	< 2	< 2	< 4	< 2	< 4	< 2	< 3	< 8	< 2	< 2	< 15	< 4
	11/05/19 - 11/26/19	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 8	< 2	< 2	< 14	< 5
	12/03/19 - 12/30/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 12	< 2	< 2	< 22	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.1 **CONCENTRATIONS OF TRITIUM IN GROUND WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	BY-14-1	BY-18-1	BY-32	BY-35	BY-37	BY-38
01/08/19 - 01/08/19	< 192	< 195	< 197	< 195	< 193	< 195
04/09/19 - 04/09/19	< 187	< 190	< 190	< 186	< 187	< 188
07/09/19 - 07/09/19	< 196	< 192	< 193	< 196	< 195	< 195
10/08/19 - 10/08/19	< 181	< 175	< 172	< 175	< 173	< 175
MEAN	-	-	-	-	-	-

Table C-II.2

CONCENTRATIONS OF GAMMA EMITTERS IN GROUND WATER SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
BY-14-1	01/08/19 - 01/08/19	< 8	< 7	< 14	< 8	< 16	< 9	< 13	< 9	< 7	< 8	< 28	< 10
	04/09/19 - 04/09/19	< 4	< 4	< 9	< 4	< 8	< 4	< 7	< 7	< 4	< 4	< 18	< 6
	07/09/19 - 07/09/19	< 7	< 6	< 14	< 7	< 15	< 7	< 13	< 10	< 7	< 6	< 28	< 11
	10/08/19 - 10/08/19	< 7	< 9	< 17	< 7	< 17	< 9	< 15	< 12	< 8	< 9	< 40	< 15
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-18-1	01/08/19 - 01/08/19	< 6	< 5	< 11	< 6	< 13	< 8	< 10	< 8	< 7	< 6	< 22	< 7
	04/09/19 - 04/09/19	< 4	< 3	< 8	< 4	< 6	< 4	< 7	< 7	< 4	< 4	< 19	< 8
	07/09/19 - 07/09/19	< 8	< 7	< 18	< 8	< 14	< 8	< 11	< 7	< 8	< 8	< 25	< 12
	10/08/19 - 10/08/19	< 7	< 7	< 16	< 7	< 18	< 8	< 11	< 12	< 7	< 7	< 29	< 9
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-32	01/08/19 - 01/08/19	< 5	< 7	< 13	< 6	< 15	< 8	< 11	< 7	< 8	< 7	< 25	< 9
	04/09/19 - 04/09/19	< 7	< 6	< 17	< 9	< 14	< 7	< 12	< 14	< 7	< 7	< 38	< 9
	07/09/19 - 07/09/19	< 7	< 7	< 13	< 6	< 15	< 6	< 12	< 9	< 9	< 7	< 24	< 13
	10/08/19 - 10/08/19	< 5	< 7	< 13	< 7	< 12	< 6	< 10	< 9	< 5	< 7	< 26	< 10
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-35	01/08/19 - 01/08/19	< 7	< 3	< 10	< 7	< 13	< 5	< 10	< 6	< 6	< 6	< 18	< 6
	04/09/19 - 04/09/19	< 5	< 6	< 16	< 6	< 11	< 7	< 12	< 13	< 9	< 7	< 33	< 14
	07/09/19 - 07/09/19	< 6	< 6	< 15	< 10	< 18	< 7	< 13	< 8	< 10	< 7	< 30	< 9
	10/08/19 - 10/08/19	< 5	< 7	< 13	< 8	< 9	< 8	< 12	< 10	< 6	< 5	< 27	< 13
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-37	01/08/19 - 01/08/19	< 7	< 6	< 11	< 6	< 12	< 6	< 11	< 7	< 8	< 7	< 23	< 8
	04/09/19 - 04/09/19	< 6	< 6	< 11	< 7	< 15	< 7	< 11	< 12	< 6	< 5	< 29	< 11
	07/09/19 - 07/09/19	< 7	< 5	< 11	< 9	< 12	< 7	< 13	< 9	< 7	< 6	< 26	< 9
	10/08/19 - 10/08/19	< 6	< 8	< 15	< 10	< 17	< 8	< 14	< 12	< 8	< 8	< 32	< 13
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-38	01/08/19 - 01/08/19	< 6	< 7	< 14	< 6	< 16	< 6	< 13	< 7	< 6	< 6	< 24	< 5
	04/09/19 - 04/09/19	< 4	< 3	< 8	< 3	< 8	< 4	< 6	< 7	< 4	< 4	< 18	< 6
	07/09/19 - 07/09/19	< 5	< 6	< 15	< 10	< 13	< 6	< 14	< 10	< 8	< 8	< 32	< 9
	10/08/19 - 10/08/19	< 5	< 5	< 14	< 8	< 11	< 8	< 12	< 8	< 5	< 7	< 24	< 14
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1

CONCENTRATIONS OF NICKEL-63 AND GAMMA EMITTERS IN FISH SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	Ni-63	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
BY-29													
Silver Redhorse	05/23/19 - 05/23/19	< 86	< 51	< 69	< 155	< 60	< 120	< 61	< 129	< 67	< 51	< 347	< 145
Shorthead Redhorse	05/23/19 - 05/23/19	< 107	< 47	< 71	< 140	< 80	< 137	< 61	< 111	< 77	< 61	< 417	< 110
Freshwater Drum	10/23/19 - 10/23/19	< 108	< 60	< 55	< 144	< 60	< 145	< 57	< 78	< 60	< 51	< 250	< 67
Shorthead Redhorse	10/23/19 - 10/23/19	< 188	< 48	< 38	< 113	< 45	< 87	< 46	< 68	< 59	< 46	< 175	< 52
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-31													
Silver Redhorse	05/23/19 - 05/23/19	< 88	< 61	< 48	< 112	< 59	< 118	< 50	< 94	< 47	< 43	< 262	< 131
Common Carp	05/23/19 - 05/23/19	< 79	< 53	< 55	< 144	< 42	< 101	< 78	< 91	< 45	< 63	< 466	< 118
Channel Catfish	10/23/19 - 10/23/19	< 132	< 37	< 53	< 102	< 50	< 152	< 47	< 61	< 42	< 48	< 183	< 74
Common Carp	10/23/19 - 10/23/19	< 157	< 44	< 39	< 93	< 58	< 141	< 55	< 87	< 35	< 49	< 281	< 105
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-IV.1

CONCENTRATIONS OF NICKEL-63 AND GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/KG DRY ± 2 SIGMA

SITE	COLLECTION PERIOD	Ni-63	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
BY-12	06/18/19 - 06/18/19	< 227	< 95	< 98	< 219	< 96	< 233	< 98	< 180	< 114	170 ± 109	< 398	< 99
	10/22/19 - 10/22/19	< 164	< 62	< 54	< 106	< 61	< 125	< 61	< 107	< 80	139 ± 65	< 240	< 69
	MEAN ± 2 STD DEV	-	-	-	-	-	-	-	-	-	154 ± 45	-	-
BY-34	06/18/19 - 06/18/19	< 233	< 95	< 84	< 137	< 72	< 171	< 87	< 142	< 108	192 ± 81	< 352	< 74
	10/22/19 - 10/22/19	< 190	< 57	< 55	< 121	< 67	< 121	< 57	< 102	< 83	242 ± 65	< 235	< 71
	MEAN ± 2 STD DEV	-	-	-	-	-	-	-	-	-	217 ± 71	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-V.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION PERIOD	GROUP I				GROUP II			GROUP III
	BY-21	BY-22	BY-23	BY-24	BY-01	BY-04	BY-06	BY-08
01/02/19 - 01/08/19	30 ± 6	23 ± 5	24 ± 5	29 ± 6	28 ± 6	31 ± 6	24 ± 5	30 ± 6
01/08/19 - 01/15/19	17 ± 4	15 ± 4	17 ± 4	15 ± 4	15 ± 4	16 ± 4	15 ± 4	15 ± 4
01/15/19 - 01/23/19	14 ± 4	12 ± 4	12 ± 4	8 ± 4	15 ± 4	12 ± 4	11 ± 4	17 ± 4
01/22/19 - 01/29/19	18 ± 4	21 ± 5	28 ± 5	24 ± 5	20 ± 4	22 ± 5	18 ± 4	24 ± 5
01/29/19 - 02/05/19	20 ± 4	17 ± 4	18 ± 4	19 ± 4	18 ± 4	13 ± 4	17 ± 4	17 ± 4
02/05/19 - 02/11/19	16 ± 5	14 ± 4	16 ± 5	15 ± 4	12 ± 4	13 ± 4	11 ± 4	13 ± 4
02/11/19 - 02/19/19	*(1)*	16 ± 4	19 ± 4	18 ± 4	21 ± 4	15 ± 4	19 ± 4	19 ± 4
02/19/19 - 02/26/19	21 ± 6	18 ± 5	21 ± 5	22 ± 5	14 ± 5	18 ± 5	20 ± 5	20 ± 5
02/26/19 - 03/05/19	25 ± 5	21 ± 5	14 ± 4	21 ± 5	18 ± 4	15 ± 4	18 ± 4	19 ± 4
03/05/19 - 03/12/19	11 ± 4	12 ± 4	14 ± 4	15 ± 4	13 ± 4	12 ± 4	10 ± 3	12 ± 4
03/12/19 - 03/19/19	10 ± 4	15 ± 4	14 ± 4	12 ± 4	12 ± 4	14 ± 4	12 ± 4	11 ± 4
03/19/19 - 03/26/19	17 ± 4	16 ± 4	14 ± 4	12 ± 4	13 ± 4	14 ± 4	16 ± 4	16 ± 4
03/26/19 - 04/02/19	10 ± 4	13 ± 4	16 ± 4	9 ± 3	17 ± 4	17 ± 4	14 ± 4	14 ± 4
04/02/19 - 04/09/19	11 ± 3	14 ± 4	14 ± 4	13 ± 4	18 ± 4	12 ± 4	14 ± 4	12 ± 3
04/09/19 - 04/16/19	6 ± 3	6 ± 3	6 ± 3	7 ± 3	6 ± 3	6 ± 3	5 ± 3	6 ± 3
04/16/19 - 04/23/19	12 ± 4	12 ± 4	12 ± 4	11 ± 4	11 ± 4	10 ± 4	11 ± 4	13 ± 4
04/23/19 - 04/30/19	13 ± 4	11 ± 4	11 ± 4	11 ± 4	11 ± 4	12 ± 4	15 ± 4	13 ± 4
04/30/19 - 05/07/19	10 ± 4	6 ± 3	5 ± 3	8 ± 3	7 ± 3	5 ± 3	8 ± 4	8 ± 3
05/07/19 - 05/14/19	10 ± 3	12 ± 4	8 ± 3	12 ± 4	9 ± 3	8 ± 3	13 ± 4	10 ± 4
05/14/19 - 05/20/19	11 ± 4	13 ± 5	9 ± 4	10 ± 4	12 ± 4	15 ± 5	11 ± 4	9 ± 4
05/20/19 - 05/28/19	7 ± 3	7 ± 3	9 ± 3	9 ± 3	8 ± 3	9 ± 3	11 ± 3	7 ± 3
05/28/19 - 06/04/19	14 ± 4	11 ± 4	*(1)*	9 ± 4	16 ± 4	12 ± 4	12 ± 4	11 ± 4
06/04/19 - 06/11/19	16 ± 4	20 ± 4	17 ± 5	16 ± 4	16 ± 4	19 ± 4	17 ± 4	14 ± 4
06/11/19 - 06/18/19	14 ± 4	10 ± 4	10 ± 4	12 ± 4	15 ± 4	14 ± 4	11 ± 4	12 ± 4
06/18/19 - 06/24/19	13 ± 4	14 ± 4	15 ± 4	14 ± 4	14 ± 4	15 ± 4	14 ± 4	15 ± 4
06/24/19 - 07/02/19	18 ± 4	17 ± 4	15 ± 3	16 ± 4	15 ± 3	18 ± 4	17 ± 4	17 ± 4
07/02/19 - 07/09/19	10 ± 4	9 ± 4	9 ± 4	8 ± 4	11 ± 4	8 ± 3	10 ± 4	11 ± 4
07/09/19 - 07/16/19	16 ± 4	14 ± 4	14 ± 4	16 ± 4	13 ± 4	14 ± 4	15 ± 4	17 ± 4
07/16/19 - 07/23/19	12 ± 4	12 ± 4	10 ± 4	13 ± 4	8 ± 4	10 ± 4	11 ± 4	11 ± 4
07/23/19 - 07/30/19	14 ± 4	13 ± 4	16 ± 4	15 ± 4	14 ± 4	16 ± 4	18 ± 4	15 ± 4
07/30/19 - 08/06/19	16 ± 4	16 ± 4	17 ± 4	14 ± 4	15 ± 4	13 ± 4	16 ± 4	18 ± 4
08/06/19 - 08/13/19	19 ± 4	16 ± 4	18 ± 4	18 ± 4	18 ± 4	17 ± 4	17 ± 4	18 ± 4
08/13/19 - 08/20/19	15 ± 4	15 ± 4	17 ± 4	18 ± 5	16 ± 4	15 ± 4	16 ± 4	17 ± 4
08/20/19 - 08/27/19	10 ± 4	12 ± 4	12 ± 4	13 ± 4	10 ± 4	11 ± 4	13 ± 4	14 ± 4
08/27/19 - 09/03/19	16 ± 4	17 ± 4	19 ± 4	14 ± 4	17 ± 4	19 ± 4	19 ± 4	18 ± 4
09/03/19 - 09/10/19	12 ± 4	16 ± 4	16 ± 4	18 ± 4	13 ± 4	17 ± 4	15 ± 4	14 ± 4
09/10/19 - 09/17/19	17 ± 5	18 ± 5	16 ± 4	18 ± 5	17 ± 5	19 ± 5	19 ± 5	15 ± 10
09/17/19 - 09/24/19	24 ± 5	22 ± 5	24 ± 5	26 ± 5	20 ± 5	26 ± 5	21 ± 5	23 ± 5
09/24/19 - 10/01/19	16 ± 4	12 ± 4	15 ± 4	17 ± 4	15 ± 4	13 ± 4	17 ± 4	12 ± 4
10/01/19 - 10/08/19	12 ± 4	10 ± 4	12 ± 4	12 ± 4	10 ± 4	11 ± 4	11 ± 4	10 ± 3
10/08/19 - 10/15/19	19 ± 5	13 ± 4	20 ± 4	15 ± 4	20 ± 5	19 ± 5	18 ± 5	16 ± 4
10/15/19 - 10/22/19	14 ± 4	12 ± 4	12 ± 4	16 ± 4	17 ± 4	14 ± 4	14 ± 4	16 ± 4
10/22/19 - 10/29/19	14 ± 4	7 ± 4	12 ± 4	12 ± 4	12 ± 4	12 ± 4	10 ± 4	9 ± 4
10/29/19 - 11/05/19	11 ± 4	11 ± 4	12 ± 4	12 ± 4	11 ± 4	12 ± 4	11 ± 4	10 ± 4
11/05/19 - 11/12/19	20 ± 4	11 ± 4	9 ± 4	11 ± 4	19 ± 4	13 ± 4	19 ± 4	19 ± 4
11/12/19 - 11/19/19	24 ± 4	24 ± 4	24 ± 4	25 ± 5	24 ± 4	28 ± 5	26 ± 5	27 ± 5
11/19/19 - 11/26/19	15 ± 4	16 ± 4	16 ± 4	12 ± 4	12 ± 4	16 ± 4	17 ± 4	14 ± 4
11/26/19 - 12/03/19	5 ± 3	4 ± 3	7 ± 3	7 ± 3	< 4	5 ± 3	5 ± 3	8 ± 3
12/03/19 - 12/10/19	18 ± 4	17 ± 4	16 ± 4	18 ± 4	18 ± 4	19 ± 4	20 ± 4	19 ± 4
12/10/19 - 12/17/19	29 ± 5	25 ± 5	17 ± 4	30 ± 5	25 ± 5	28 ± 5	27 ± 5	24 ± 5
12/17/19 - 12/23/19	32 ± 6	32 ± 6	29 ± 6	32 ± 6	33 ± 6	31 ± 6	32 ± 6	33 ± 6
12/23/19 - 12/30/19	27 ± 5	24 ± 4	20 ± 4	21 ± 4	21 ± 4	26 ± 5	20 ± 4	23 ± 4
MEAN ± 2 STD DEV	16 ± 12	15 ± 11	15 ± 10	15 ± 12	15 ± 10	15 ± 12	15 ± 10	15 ± 11

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-V.2 **MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

GROUP I - NEARSITE LOCATIONS				GROUP II - FAR FIELD LOCATIONS				GROUP III - CONTROL LOCATIONS			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
01/02/19 - 01/29/19	8	30	19 ± 13	01/02/19 - 01/29/19	11	31	19 ± 12	01/02/19 - 01/29/19	15	30	21 ± 13
01/29/19 - 02/26/19	14	22	18 ± 5	01/29/19 - 02/26/19	11	21	16 ± 7	01/29/19 - 02/26/19	13	20	17 ± 6
02/26/19 - 04/02/19	9	25	15 ± 8	02/26/19 - 04/02/19	10	18	14 ± 5	02/26/19 - 04/02/19	11	19	14 ± 7
04/02/19 - 04/30/19	6	14	11 ± 6	04/02/19 - 04/30/19	5	18	11 ± 8	04/02/19 - 04/30/19	6	13	11 ± 6
04/30/19 - 06/04/19	5	14	10 ± 5	04/30/19 - 06/04/19	5	16	10 ± 6	04/30/19 - 06/04/19	7	11	9 ± 3
06/04/19 - 07/02/19	10	20	15 ± 6	06/04/19 - 07/02/19	11	19	15 ± 4	06/04/19 - 07/02/19	12	17	15 ± 4
07/02/19 - 07/30/19	8	16	13 ± 5	07/02/19 - 07/30/19	8	18	12 ± 7	07/02/19 - 07/30/19	11	17	14 ± 6
07/30/19 - 09/03/19	10	19	15 ± 5	07/30/19 - 09/03/19	10	19	15 ± 5	07/30/19 - 09/03/19	14	18	17 ± 3
09/03/19 - 10/01/19	12	26	18 ± 8	09/03/19 - 10/01/19	13	26	18 ± 7	09/03/19 - 10/01/19	12	23	16 ± 9
10/01/19 - 10/29/19	7	20	13 ± 6	10/01/19 - 10/29/19	10	20	14 ± 7	10/01/19 - 10/29/19	9	16	13 ± 8
10/29/19 - 12/03/19	4	25	14 ± 13	10/29/19 - 12/03/19	5	28	16 ± 14	10/29/19 - 12/03/19	8	27	15 ± 16
12/03/19 - 12/30/19	16	32	24 ± 12	12/03/19 - 12/30/19	18	33	25 ± 11	12/03/19 - 12/30/19	19	33	25 ± 12
01/02/19 - 12/30/19	4	32	15 ± 11	01/02/19 - 12/30/19	5	33	15 ± 11	01/02/19 - 12/30/19	6	33	15 ± 11

Table C-V.3

CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
BY-01	01/02/19 - 04/02/19	< 3	< 5	< 12	< 4	< 6	< 4	< 8	< 4	< 2	< 196	< 60
	04/02/19 - 07/02/19	< 3	< 6	< 12	< 3	< 5	< 5	< 9	< 3	< 2	< 338	< 127
	07/02/19 - 10/01/19	< 3	< 4	< 12	< 3	< 6	< 4	< 7	< 3	< 2	< 193	< 79
	10/01/19 - 12/30/19	< 2	< 4	< 8	< 1	< 5	< 3	< 5	< 2	< 1	< 126	< 34
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-04	01/02/19 - 04/02/19	< 2	< 4	< 11	< 2	< 7	< 4	< 7	< 3	< 2	< 187	< 8
	04/02/19 - 07/02/19	< 2	< 3	< 12	< 2	< 5	< 5	< 5	< 3	< 2	< 272	< 84
	07/02/19 - 10/01/19	< 3	< 3	< 13	< 2	< 6	< 4	< 7	< 3	< 2	< 162	< 87
	10/01/19 - 12/30/19	< 2	< 4	< 14	< 3	< 6	< 3	< 7	< 3	< 2	< 192	< 79
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-06	01/02/19 - 04/02/19	< 3	< 4	< 14	< 3	< 8	< 5	< 8	< 3	< 3	< 230	< 86
	04/02/19 - 07/02/19	< 3	< 5	< 16	< 2	< 7	< 5	< 7	< 3	< 2	< 290	< 117
	07/02/19 - 10/01/19	< 2	< 2	< 9	< 2	< 5	< 3	< 5	< 2	< 2	< 131	< 52
	10/01/19 - 12/30/19	< 2	< 3	< 8	< 3	< 6	< 4	< 8	< 2	< 2	< 139	< 86
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-08	01/02/19 - 04/02/19	< 2	< 3	< 13	< 3	< 8	< 4	< 7	< 3	< 3	< 179	< 70
	04/02/19 - 07/02/19	< 2	< 3	< 11	< 3	< 6	< 4	< 7	< 2	< 2	< 247	< 80
	07/02/19 - 10/01/19	< 2	< 3	< 12	< 2	< 4	< 4	< 7	< 2	< 2	< 104	< 64
	10/01/19 - 12/30/19	< 2	< 4	< 8	< 2	< 6	< 3	< 6	< 2	< 2	< 161	< 33
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-V.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
BY-21	01/02/19 - 04/02/19	< 3	< 6	< 13	< 4	< 7	< 6	< 10	< 4	< 3	< 272	< 89
	04/02/19 - 07/02/19	< 3	< 5	< 12	< 3	< 9	< 5	< 7	< 2	< 2	< 315	< 141
	07/02/19 - 10/01/19	< 3	< 3	< 11	< 3	< 6	< 4	< 6	< 2	< 3	< 175	< 72
	10/01/19 - 12/30/19	< 2	< 3	< 11	< 2	< 6	< 4	< 7	< 3	< 2	< 181	< 84
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-22	01/02/19 - 04/02/19	< 3	< 4	< 7	< 2	< 6	< 4	< 9	< 3	< 3	< 204	< 79
	04/02/19 - 07/02/19	< 2	< 3	< 15	< 3	< 6	< 4	< 7	< 2	< 2	< 259	< 125
	07/02/19 - 10/01/19	< 3	< 4	< 8	< 2	< 6	< 4	< 9	< 3	< 2	< 174	< 55
	10/01/19 - 12/30/19	< 3	< 4	< 15	< 4	< 8	< 4	< 8	< 3	< 3	< 211	< 59
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-23	01/02/19 - 04/02/19	< 3	< 5	< 12	< 4	< 8	< 5	< 9	< 4	< 3	< 224	< 74
	04/02/19 - 07/02/19	< 3	< 4	< 11	< 4	< 7	< 4	< 8	< 3	< 2	< 306	< 116
	07/02/19 - 10/01/19	< 3	< 4	< 14	< 2	< 5	< 4	< 6	< 3	< 2	< 204	< 80
	10/01/19 - 12/30/19	< 2	< 2	< 8	< 3	< 4	< 3	< 6	< 2	< 2	< 149	< 46
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-24	01/02/19 - 04/02/19	< 2	< 3	< 10	< 3	< 7	< 3	< 7	< 2	< 2	< 163	< 52
	04/02/19 - 07/02/19	< 2	< 4	< 8	< 3	< 6	< 4	< 6	< 2	< 2	< 237	< 88
	07/02/19 - 10/01/19	< 2	< 3	< 10	< 2	< 5	< 3	< 8	< 2	< 2	< 187	< 35
	10/01/19 - 12/30/19	< 1	< 3	< 8	< 2	< 5	< 4	< 4	< 2	< 2	< 156	< 46
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-VI.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION	GROUP I				GROUP II			GROUP III
PERIOD	BY-21	BY-22	BY-23	BY-24	BY-01	BY-04	BY-06	BY-08
01/02/19 - 01/08/19	< 31	< 31	< 31	< 31	< 19	< 18	< 15	< 18
01/08/19 - 01/15/19	< 46	< 46	< 46	< 46	< 54	< 55	< 55	< 54
01/15/19 - 01/23/19	< 60	< 50	< 50	< 60	< 62	< 51	< 63	< 52
01/22/19 - 01/29/19	< 55	< 62	< 63	< 56	< 49	< 55	< 48	< 53
01/29/19 - 02/05/19	< 63	< 63	< 64	< 64	< 49	< 51	< 51	< 49
02/05/19 - 02/11/19	< 45	< 45	< 44	< 44	< 53	< 51	< 52	< 52
02/11/19 - 02/19/19	*(1)*	< 48	< 48	< 49	< 41	< 42	< 42	< 42
02/19/19 - 02/26/19	< 52	< 46	< 47	< 46	< 29	< 28	< 29	< 29
02/26/19 - 03/05/19	< 48	< 48	< 48	< 48	< 25	< 26	< 26	< 26
03/05/19 - 03/12/19	< 63	< 63	< 62	< 62	< 54	< 53	< 53	< 53
03/12/19 - 03/19/19	< 33	< 33	< 33	< 34	< 51	< 51	< 50	< 50
03/19/19 - 03/26/19	< 46	< 46	< 46	< 46	< 66	< 65	< 66	< 66
03/26/19 - 04/02/19	< 44	< 44	< 44	< 44	< 31	< 32	< 32	< 32
04/02/19 - 04/09/19	< 39	< 39	< 40	< 40	< 27	< 26	< 26	< 26
04/09/19 - 04/16/19	< 59	< 59	< 59	< 59	< 29	< 36	< 35	< 35
04/16/19 - 04/23/19	< 41	< 41	< 41	< 41	< 35	< 34	< 34	< 35
04/23/19 - 04/30/19	< 41	< 40	< 40	< 17	< 34	< 34	< 34	< 34
04/30/19 - 05/07/19	< 42	< 42	< 42	< 42	< 23	< 24	< 24	< 24
05/07/19 - 05/14/19	< 45	< 45	< 45	< 45	< 31	< 30	< 30	< 30
05/14/19 - 05/20/19	< 28	< 15	< 27	< 27	< 30	< 30	< 30	< 30
05/20/19 - 05/28/19	< 52	< 52	< 52	< 51	< 32	< 32	< 32	< 32
05/28/19 - 06/04/19	< 18	< 17	*(1)*	< 17	< 29	< 29	< 30	< 30
06/04/19 - 06/11/19	< 11	< 39	< 45	< 39	< 26	< 27	< 26	< 26
06/11/19 - 06/18/19	< 53	< 53	< 53	< 53	< 32	< 31	< 32	< 32
06/18/19 - 06/24/19	< 28	< 28	< 28	< 28	< 58	< 58	< 58	< 59
06/24/19 - 07/02/19	< 15	< 45	< 46	< 45	< 35	< 36	< 36	< 36
07/02/19 - 07/09/19	< 36	< 36	< 35	< 35	< 51	< 51	< 51	< 21
07/09/19 - 07/16/19	< 56	< 56	< 55	< 23	< 32	< 33	< 33	< 34
07/16/19 - 07/23/19	< 29	< 29	< 29	< 30	< 16	< 16	< 16	< 16
07/23/19 - 07/30/19	< 55	< 55	< 55	< 55	< 33	< 33	< 33	< 34
07/30/19 - 08/06/19	< 26	< 23	< 54	< 54	< 31	< 31	< 31	< 31
08/06/19 - 08/13/19	< 43	< 43	< 43	< 43	< 21	< 26	< 26	< 26
08/13/19 - 08/20/19	< 28	< 28	< 12	< 34	< 42	< 41	< 41	< 41
08/20/19 - 08/27/19	< 48	< 48	< 48	< 48	< 25	< 61	< 61	< 62
08/27/19 - 09/03/19	< 38	< 62	< 59	< 61	< 36	< 36	< 35	< 29
09/03/19 - 09/10/19	< 44	< 43	< 43	< 18	< 36	< 36	< 36	< 36
09/10/19 - 09/17/19	< 37	< 37	< 15	< 36	< 26	< 25	< 26	< 60
09/17/19 - 09/24/19	< 65	< 65	< 65	< 65	< 39	< 39	< 39	< 39
09/24/19 - 10/01/19	< 23	< 63	< 61	< 61	< 52	< 49	< 48	< 48
10/01/19 - 10/08/19	< 40	< 28	< 27	< 27	< 40	< 41	< 35	< 39
10/08/19 - 10/15/19	< 26	< 26	< 24	< 25	< 24	< 24	< 25	< 24
10/15/19 - 10/22/19	< 59	< 59	< 49	< 58	< 38	< 38	< 39	< 38
10/22/19 - 10/29/19	< 53	< 53	< 53	< 53	< 41	< 42	< 42	< 42
10/29/19 - 11/05/19	< 15	< 15	< 15	< 15	< 10	< 22	< 22	< 23
11/05/19 - 11/12/19	< 18	< 18	< 18	< 18	< 9	< 22	< 22	< 22
11/12/19 - 11/19/19	< 41	< 41	< 41	< 49	< 60	< 61	< 61	< 61
11/19/19 - 11/26/19	< 68	< 68	< 68	< 68	< 50	< 50	< 50	< 50
11/26/19 - 12/03/19	< 36	< 36	< 36	< 36	< 34	< 34	< 35	< 35
12/03/19 - 12/10/19	< 28	< 28	< 28	< 28	< 41	< 41	< 41	< 41
12/10/19 - 12/17/19	< 21	< 21	< 21	< 17	< 32	< 33	< 33	< 33
12/17/19 - 12/23/19	< 24	< 52	< 53	< 52	< 58	< 58	< 58	< 58
12/23/19 - 12/30/19	< 53	< 53	< 53	< 53	< 50	< 50	< 50	< 50
MEAN	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.1 CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CONTROL FARM BY-26-2	INDICATOR FARM BY-20-1
01/02/19	< 0.8	< 0.7
02/05/19	< 0.7	< 0.6
03/05/19	< 0.6	< 0.6
04/02/19	< 0.8	< 0.9
05/07/19	< 0.7	< 0.6
05/20/19	< 0.8	< 1.0
06/04/19	< 0.6	< 0.5
06/18/19	< 0.9	< 0.9
07/02/19	< 0.8	< 0.8
07/16/19	< 0.5	< 0.5
07/30/19	< 0.8	< 0.7
08/13/19	< 0.8	< 0.7
08/27/19	< 0.7	< 0.7
09/10/19	< 1.0	< 0.9
09/24/19	< 0.7	< 0.7
10/08/19	< 0.8	< 0.8
10/22/19	< 0.9	< 0.9
11/05/19	< 0.6	< 0.9
12/03/19	< 0.7	< 0.8
MEAN	-	-

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
BY-20-1	01/02/19	< 6	< 7	< 19	< 8	< 16	< 7	< 13	< 8	< 7	< 33	< 8
	02/05/19	< 7	< 8	< 17	< 10	< 17	< 7	< 11	< 7	< 8	< 29	< 11
	03/05/19	< 7	< 7	< 17	< 10	< 16	< 9	< 15	< 8	< 8	< 33	< 7
	04/02/19	< 7	< 7	< 14	< 9	< 18	< 7	< 12	< 9	< 8	< 31	< 13
	05/07/19	< 7	< 8	< 13	< 6	< 17	< 6	< 12	< 7	< 7	< 24	< 8
	05/20/19	< 6	< 7	< 15	< 8	< 17	< 7	< 12	< 7	< 7	< 22	< 9
	06/04/19	< 9	< 9	< 19	< 13	< 22	< 9	< 15	< 12	< 12	< 40	< 10
	06/18/19	< 8	< 9	< 22	< 12	< 24	< 10	< 15	< 7	< 8	< 42	< 9
	07/02/19	< 4	< 4	< 9	< 5	< 9	< 4	< 6	< 5	< 4	< 15	< 5
	07/16/19	< 6	< 6	< 13	< 6	< 11	< 5	< 10	< 6	< 5	< 23	< 5
	07/30/19	< 6	< 8	< 16	< 9	< 17	< 7	< 13	< 9	< 8	< 38	< 11
	08/13/19	< 8	< 8	< 18	< 9	< 16	< 8	< 13	< 8	< 9	< 31	< 8
	08/27/19	< 7	< 7	< 17	< 7	< 15	< 7	< 11	< 6	< 6	< 38	< 14
	09/10/19	< 8	< 10	< 19	< 9	< 26	< 10	< 15	< 7	< 8	< 40	< 11
	09/24/19	< 8	< 8	< 18	< 11	< 21	< 8	< 14	< 8	< 8	< 36	< 10
	10/08/19	< 8	< 9	< 23	< 10	< 25	< 9	< 15	< 8	< 10	< 44	< 15
	10/22/19	< 9	< 8	< 18	< 8	< 20	< 8	< 16	< 8	< 9	< 26	< 10
	11/05/19	< 6	< 6	< 16	< 5	< 18	< 8	< 12	< 7	< 8	< 27	< 7
	12/03/19	< 9	< 9	< 21	< 9	< 23	< 8	< 16	< 9	< 11	< 30	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-
BY-26-2	01/02/19	< 8	< 8	< 21	< 10	< 18	< 9	< 16	< 10	< 9	< 43	< 11
	02/05/19	< 7	< 7	< 13	< 8	< 14	< 6	< 11	< 7	< 7	< 27	< 10
	03/05/19	< 9	< 9	< 22	< 10	< 24	< 10	< 17	< 11	< 9	< 42	< 11
	04/02/19	< 9	< 8	< 17	< 7	< 17	< 7	< 13	< 9	< 7	< 36	< 13
	05/07/19	< 9	< 9	< 16	< 9	< 16	< 8	< 11	< 8	< 11	< 33	< 11
	05/20/19	< 8	< 7	< 15	< 7	< 16	< 6	< 11	< 8	< 7	< 30	< 8
	06/04/19	< 7	< 8	< 19	< 9	< 19	< 7	< 14	< 9	< 8	< 40	< 12
	06/18/19	< 6	< 8	< 15	< 9	< 18	< 7	< 10	< 8	< 8	< 37	< 11
	07/02/19	< 3	< 4	< 9	< 4	< 9	< 3	< 7	< 5	< 3	< 12	< 4
	07/16/19	< 8	< 7	< 18	< 10	< 18	< 9	< 15	< 8	< 8	< 32	< 9
	07/30/19	< 7	< 8	< 20	< 8	< 17	< 8	< 18	< 10	< 9	< 43	< 12
	08/13/19	< 6	< 6	< 11	< 7	< 17	< 8	< 12	< 7	< 7	< 26	< 7
	08/27/19	< 7	< 7	< 14	< 6	< 18	< 6	< 13	< 7	< 6	< 31	< 10
	09/10/19	< 9	< 10	< 21	< 10	< 19	< 8	< 14	< 10	< 8	< 37	< 12
	09/24/19	< 9	< 9	< 21	< 11	< 22	< 9	< 14	< 11	< 10	< 45	< 7
	10/08/19	< 7	< 7	< 17	< 8	< 19	< 6	< 12	< 8	< 8	< 34	< 12
	10/22/19	< 7	< 7	< 18	< 11	< 16	< 7	< 13	< 8	< 7	< 21	< 7
	11/05/19	< 7	< 7	< 16	< 7	< 15	< 8	< 14	< 8	< 7	< 25	< 7
	12/03/19	< 7	< 8	< 14	< 7	< 15	< 7	< 12	< 7	< 7	< 34	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-VIII.1

CONCENTRATIONS OF GAMMA EMITTERS IN VEGETATION SAMPLES COLLECTED IN THE VICINITY OF BYRON NUCLEAR GENERATING STATION, 2019

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
BY-CONTROL													
Cabbage	08/12/19	< 14	< 15	< 31	< 21	< 40	< 20	< 23	< 20	< 18	< 21	< 75	< 19
Zucchini	08/12/19	< 13	< 13	< 24	< 17	< 30	< 18	< 24	< 16	< 17	< 12	< 60	< 14
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-QUAD 1													
Beet Leaves	08/13/19	< 21	< 18	< 37	< 20	< 45	< 18	< 33	< 24	< 23	< 23	< 79	< 22
Beets	08/13/19	< 30	< 28	< 59	< 32	< 58	< 31	< 54	< 39	< 34	< 33	< 124	< 32
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-QUAD 2													
Cabbage	08/14/19	< 20	< 18	< 42	< 24	< 40	< 26	< 36	< 29	< 24	< 25	< 99	< 28
Potatoes	08/14/19	< 25	< 29	< 71	< 38	< 74	< 35	< 52	< 46	< 28	< 36	< 112	< 44
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-QUAD 3													
Carrots/Rutabaga	08/14/19	< 28	< 22	< 61	< 32	< 53	< 32	< 42	< 35	< 30	< 26	< 103	< 38
Cabbage	08/14/19	< 33	< 24	< 67	< 28	< 70	< 32	< 39	< 44	< 32	< 26	< 116	< 32
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
BY-QUAD 4													
Cabbage	08/13/19	< 22	< 20	< 46	< 27	< 51	< 22	< 43	< 38	< 23	< 24	< 117	< 37
Zucchini	08/13/19	< 21	< 21	< 40	< 16	< 42	< 20	< 32	< 35	< 21	< 17	< 64	< 16
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-