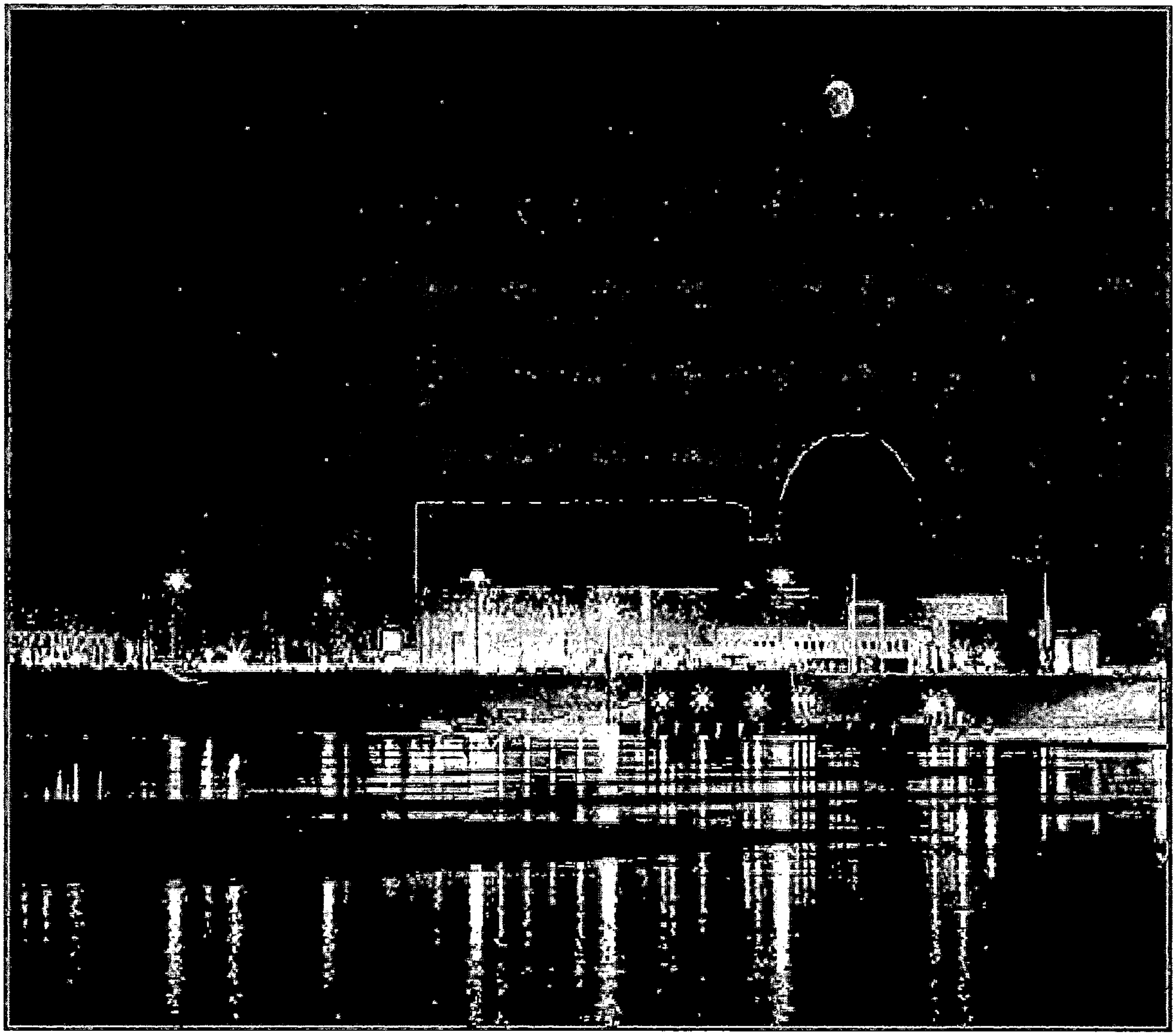


Exelon Generation.

January 01, 2018 – December 31, 2018

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

CLINTON POWER STATION – DOCKET NUMBER 50-461

Prepared by:

Teledyne Brown Engineering Environmental Services
April 2019

Table Of Contents

Appendices

I. Summary and Conclusions

This report on the Radiological Environmental Monitoring Program (REMP) conducted for the Clinton Power Station (CPS) by Exelon Generation Company, LLC (Exelon) covers the period January 1, 2018 through December 31, 2018. During that time period, 1,552 analyses were performed on 1,425 samples. In assessing all the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of CPS had no adverse radiological impact on the environment.

There were zero (0) radioactive liquid releases from CPS during 2018. Releases of gaseous radioactive materials were accurately measured in plant effluents. There were no gaseous effluent releases that approached the limits specified in the CPS Offsite Dose Calculation Manual (ODCM). The highest calculated offsite dose received by a member of the public in 2018 due to the release of gaseous effluents from CPS was 4.69E-02 or 0.0469 mRem.

Surface, drinking, and well water samples were analyzed for concentrations of tritium and gamma-emitting nuclides. Drinking water samples were also analyzed for concentrations of gross beta and Iodine-131 (I-131). No fission or activation products were detected. No tritium or gross beta activity was detected and the required lower limit of detection (LLD) was met.

Fish and shoreline sediment samples were analyzed for concentrations of gamma-emitting nuclides. No fission or activation products were detected in fish or shoreline sediment samples.

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

Iodine-131 analyses were performed on weekly air samples. All results were less than the lower limit of detection for I-131.

High sensitivity I-131 analyses and gamma analyses were performed on cow milk samples. All results were below the required LLDs for I-131. Concentrations of naturally-occurring K-40 were consistent with those detected in previous years. 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.

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

Environmental gamma radiation measurements were performed quarterly using Dosimeters of Legal Record (DLR). Levels detected were consistent with those observed in previous years.

II. Introduction

The Clinton Power Station (CPS), consisting of one approximately 1,140 MW gross electrical power output boiling water reactor is located in Harp Township, DeWitt County, Illinois. CPS is owned and operated by Exelon and became operational in 1987. Unit No. 1 went critical on February 27, 1987. The site encloses approximately 13,730 acres. This includes the 4,895 acre, man-made cooling lake and about 452 acres of property not owned by Exelon. The plant is situated on approximately 150 acres. The cooling water discharge flume – which discharges to the eastern arm of the lake – occupies an additional 130 acres. Although the nuclear reactor, supporting equipment and associated electrical generation and distribution equipment lie in Harp Township, portions of the aforementioned 13,730 acre plot reside within Wilson, Rutledge, DeWitt, Creek, Nixon and Santa Anna Townships.

A Radiological Environmental Monitoring Program (REMP) for CPS was initiated in 1987. The preoperational period for most media covers the periods May 1980 through February 27, 1987 and was summarized in a separate report. This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Landauer on samples collected during the period January 1, 2018 through December 31, 2018.

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

This section describes the general collection methods used by Environmental Inc. (Midwest Labs) to obtain environmental samples for the CPS REMP in 2018. Sample locations and descriptions can be found in Tables B–1 and B–2, and Figures B–1 through B–4, Appendix B. The sampling methods used by Environmental Inc. (Midwest Labs) are listed in Table B-2.

<u>Aquatic Environment</u>

The aquatic environment was evaluated by performing radiological analyses on samples of surface water, drinking water, well water, fish, and shoreline sediment. Two gallon water samples were collected monthly from composite samplers located at three surface water locations (CL-90, CL-91 and CL-99) and one drinking water location (CL-14). A monthly grab sample was obtained from one surface water location (CL-13). Quarterly samples were obtained from two well water locations (CL-7D and CL-12). All samples were collected in new unused plastic bottles, which were rinsed at least twice with source water prior to collection. Fish samples comprising the flesh of largemouth bass, crappie, carp, bluegill, and channel catfish, the species most commonly harvested from the lakes by sporting fishermen, were collected semiannually at two locations, CL-19 and CL-105. CL-105 was the control location, which is located about 50 miles upwind of the station. Shoreline sediment samples composed of recently deposited substrate were collected at two locations semiannually (CL-07B and CL-105 (control)).

<u>Atmospheric Environment</u>

The atmospheric environment was evaluated by performing radiological analyses on samples of air particulate, airborne iodine, milk, food produce and grass. Airborne iodine and particulate samples were collected and analyzed weekly at ten locations (CL-1, CL-2, CL-3, CL-4, CL-6, CL-7, CL-8, CL-11, CL-15 and CL-94). CL-11 was the control location, which is located 16 miles upwind of the station. Airborne iodine and particulate samples were obtained at each location, using a vacuum pump with charcoal and glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The filters were replaced weekly and sent to an independent laboratory for analysis.

Milk samples were collected biweekly at one location (CL-116) from May through October to coincide with the grazing season, and monthly from November through April. All samples were collected in new unused plastic bottles from the bulk tank at the dairy farm, preserved with sodium bisulfite and shipped promptly to the laboratory.

Food products were collected once a month from June through September at four locations (CL-114, CL-115, CL-117 and CL-118). The control location was CL-114, which is located 12.5 miles upwind of the station. Various broadleaf vegetable samples were collected and placed in new unused plastic bags, and sent to the laboratory for analysis.

Grass samples were collected biweekly at four locations (CL-01, CL-02, CL-08 and CL-116) from May through October. CL-116 was the control location, which is located 14 miles WSW of the station. All samples were collected in new unused plastic bags and sent to the laboratory for analysis.

Ambient Gamma Radiation

Direct radiation measurements were made using DLRs. Each location consisted of 2 dosimeter sets in a vented PVC conduit located a few feet off the ground. The DLRs were exchanged quarterly and sent to Landauer for analysis. The DLR locations were placed around the CPS site as follows:

An inner ring consisting of 16 locations (CL-1, CL-5, CL-22, CL-23, CL-24, CL-34, CL-35, CL-36, CL-42 CL-43, CL-44, CL-45, CL-46, CL-47, CL-48 and CL-63).

An outer ring consisting of 16 locations (CL-51, CL-52, CL-53, CL-54, CL-55, CL-56, CL-57, CL-58, CL-60, CL-61, CL-76, CL-77, CL-78, CL-79, CL-80 and CL-81).

A special interest set consisting of seven locations (CL-37, CL-41, CL-49, CL-64, CL-65, CL-74 and CL-75) representing special interest areas.

A supplemental set consisting of 14 locations (CL-2, CL-3, CL-4, CL-6, CL-7, CL-8, CL-15, CL-33, CL-84, CL-90, CL-91, CL-97, CL-99 and CL-114).

CL-11 represents the control location for all environmental DLRs.

The specific DLR 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 meteorological sectors around the site, where estimated annual dose from CPS, if

detected, would be most significant;

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

4. And near the closest dwelling to the HVAC and VG stacks in the prevailing downwind direction.

B. Sample Analysis

This section describes the general analytical methodologies used by TBE and Environmental Inc. (Midwest Labs) to analyze the environmental samples for radioactivity for the CPS REMP in 2018. The analytical procedures used by the laboratories 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 drinking water and air particulates

2. Concentrations of gamma emitters in surface, drinking and well water, air particulates, milk, fish, grass, sediment and vegetables

3. Concentrations of tritium in surface, drinking and well water

4. Concentrations of I-131 in air, milk, drinking water and surface water

5. Ambient gamma radiation levels at various off-site environs

C. Data Interpretation

The radiological and direct radiation data collected prior to CPS becoming operational was used as a baseline with which these operational data were compared. For the purpose of this report, CPS 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. <u>Lower Limit of Detection and Minimum Detectable Concentration</u>

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" value. 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 CPS detection capabilities for environmental sample analysis.

2. <u>Net Activity Calculation and Reporting of Results</u>

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 resulting in a negative number. A minimum detectable concentration (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, drinking water, well water, fish, and sediment: 12 nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, Cs-134, Cs-137, Ba-140, La-140 and Ce-144 were reported

For milk: 13 nuclides, K-40, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, Cs-134, Cs-137, Ba-140, La-140 and Ce-144 were reported

For grass and vegetation: 13 nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140, La-140 and Ce-144 were reported

For air particulate: 9 nuclides, Co-60, Nb-95, Zr-95, Ru-103, Ru-106, Cs-134, Cs-137, Ce-141 and Ce-144 were reported

The mean and standard deviation of the results were calculated. The standard deviation represents the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

The exceptions (Issue Reports, IRs) described below are those that are considered 'deviations' from the Radiological Environmental Monitoring Program as required by the Station's ODCM. By definition, 'deviations' are permitted as delineated within NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", October 1978, and within Radiological Assessment Branch Technical Position, Revision 1, November 1979, which states.... "Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons".... The below section addresses the reporting requirements found within Section 6.0 of the Station's ODCM.

Exceptions/Anomalies

1. IR 4096676 Non-ODCM CL-1 Timer Shortage
   01/24/2018-During the weekly particulate and iodine sampling activities on 1/24/2018, the REMP sample collection vendor Environmental Inc. found non-ODCM air sampler CL-1 with a timer reading shortage of approximately 2 hours. This indicates a power outage at some point during the sampling week. The sampler was back up and running as expected. The sample is sufficient for analysis.

2. IR 4104312 ODCM Air Samplers CL-7, CL-8, CL-15 & CL-94 Timer Shortages
   02/14/2018-During the weekly airborne iodine and particulate surveillance performed on 2/14/2018, the sampling vendor Environmental, Inc. found two ODCM air samplers CL-8 and CL-15 and two non-ODCM air samplers CL-7 and CL-94 with timer reading shortages indicating a power outage during the collection week. The timers were all back up and running appropriately. The samples are sufficient for analysis, but the sample collections were not continuous as required by the ODCM.

3. IR 4112366 ODCM Environmental Area TLD's CL-35 Missing
   Clinton's ODCM Table 4.6-1 (1) requires Direct Radiation Monitoring at both inner and outer rings surrounding Clinton Power Station. Within these requirements, specific reference is made to having monitoring capabilities at CL-35, a location in the Northwest Inner Ring Meteorological Sector, located 0.7 miles from the centerline of our Station HVAC Stack. This Environmental Area TLDs are exchanged quarterly per the ODCM Table, but weekly verifications are performed to ensure we are capturing the direct radiation throughout the quarter.

   Contrary to the above requirement, our ODCM Sample Collector Vendor reported that during the verification of ODCM REMP TLDs under WO 4752566, the two TLDs located at CL-35 were missing. The vendor was able to replace these two TLDs with the spares that are kept in a lead shielded box prior to/if use is required throughout the quarter.

4. IR 4125532 ODCM Air Samplers CL-3, CL-4 & CL-6 Timer Shortages
   04/11/2018-During the weekly ODCM air sampling surveillance on Wednesday 4/11/2018, the Environmental Inc. sampling vendor identified that one ODCM air sample location, CL-3, and two non-ODCM sample locations, CL-4 and CL-6, timers were short approximately 4 to 8 hours. The samplers and timers were back up and running as expected. This indicates a power outage at some point during the sampling week. The samples are sufficient for analysis, but the sample collections were not continuous as required by the ODCM.

5. IR 4128517 ODCM Water Compositor CL-91 Sample Line or Header Clogged
   04/18/2018-During the routine weekly compositor check performed on 4/18/2018, the sampling vendor, Environmental Inc. found ODCM upstream surface water compositor CL-91 unable to obtain a sample due to an apparent blockage in the sample line extending into Clinton Lake. Troubleshooting of the compositor indicates that the compositor itself and the heat trace are functioning as expected, however, no air could be forced backwards through the sampling line extending into the lake. Once the header and sample line were cleared, the compositor was functioning as normal.

6. IR 4138861 ODCM & Non-ODCM Air Samplers Timer Shortages
   05/16/2018- During the weekly ODCM air sampling surveillance on Wednesday 05/16/2018, the Environmental Inc. sampling vendor identified that all the timers besides CL-1 and CL-11 were short indicating power outages at some point during the sampling week. Significant storms went through the area during the week, which could have potentially caused these outages. Every sampler and timer were back up and running as expected. The samples are sufficient for analysis, but the sample collections were not continuous as required by the ODCM.

7. IR 4151028 ODCM Insufficient Vegetation for the June 2018 REMP Sampling
   06/27/2018- During the vegetation sampling on 06/27/2018, the vendor collector could not obtain enough vegetation samples for the June 2018 monthly sample at CL-115 and CL-118. Nearby broadleaf weeds and corn leaves were collected as a substitute samples.

8. IR 4158990 ODCM Insufficient Vegetation for the July 2018 REMP Sampling
   07/25/2018- During the vegetation sampling on 07/25/2018, the vendor collector could not obtain enough vegetation samples for the July 2018 monthly sample at CL-115 and CL-118. Nearby broadleaf weeds and corn leaves were collected as a substitute samples.

9. IR 4168514 ODCM Insufficient Vegetation for the August 2018 REMP Sampling
   08/29/2018- During the vegetation sampling on 08/29/2018 under the WO 4811564, the vendor collector could not obtain enough vegetation samples for the August 2018 monthly sample at CL-114, CL-115 and CL-118. Three types of broadleaf vegetation were appropriately obtained from CL-117. CL-114, the control garden located in approximately 12.5 miles SSE of CPS, only had cabbage available for sampling. Nearby broadleaf weeds and corn leaves were collected as a substitute samples for CL-115 and CL-118.

10. IR 4177596 ODCM Insufficient Vegetation for the September 2018 REMP Sampling
    09/27/2018- During the vegetation sampling on 09/27/2018 under the WO 4824687, the vendor collector could not obtain enough vegetation samples for the September 2018 monthly sample at CL-114, CL-115 and CL-118. The remaining cabbage and some week substitutes were collected at CL-114, while nearby corn leaves were collected as a substitute CL-115 sample and nearby broadleaf weeds were collected as a substitute CL-118 sample

11. IR 4194818 Non-ODCM Heater at Water Compositor CL-99 Not Functioning
    11/14/2018- During the weekly compositor check performed on 11/14/2018, the sampling vendor from Environmental Inc. found that the non-ODCM water compositor CL-99 was without heat. The compositor and sampler are frozen due to the heater being out of service, therefore not allowing the 20 mL per hour aliquot sample to be collected until fixed. Once the heater was fixed, the compositor was functioning as normal, but grab samples were taken on 12/5/18 and 12/12/18 to make up for the loss composite time.

Throughout 2018, the following IRs were generated to document Program exceptions that were entered into the corrective action program for trending purposes.

Missed Samples

1. IR 4090070 No Samples Obtained at CL-90 and CL-99
   During the weekly compositor checks and sample collection performed during the month of January, the sampling vendor from Environmental Inc. found that the ODCM required sampling point CL-90 was without heat and non-ODCM sample point CL-99 was frozen. No representative grab samples were able to be obtained on either compositor due to the frozen water intake areas.

2. <u>IR 4163281 REMP Weekly Air Particulate and Iodine Cartridges Missing</u>
07/25/2018- Notified by Teledyne Brown Engineering and Environmental Inc. that the weekly air particulate and iodine cartridges collected on 7/25/18 under WO 04809207 were lost by FedEx. The Environmental Inc. Sampling Vendor shipped the cartridges and other samples (such as vegetation, surface water, etc.) collected on 7/25/18 via FedEx on 7/26/18, but the cartridges never arrived at Teledyne Brown as of 8/10/18. The other samples collected on 7/25/18 appropriately arrived at Teledyne Brown.

Program exceptions were reviewed to understand the causes of the exception and to return to ODCM sample compliance before the next sampling frequency period.

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 2018.

IV. Results and Discussion

A. Aquatic Environment

1. Surface Water

Composite samples were taken hourly at three locations (CL-90, CL-91 and CL-99) on a monthly schedule and grab samples were taken monthly from one location (CL-13). The following analyses were performed:

<u>Iodine-131</u>

Monthly samples from location CL-90 were analyzed for I-131 activity (Table C-I.1, Appendix C). No I-131 was detected in any samples and the required LLD was met.

<u>Tritium</u>

Monthly samples from all locations were composited quarterly and analyzed for tritium activity (Table C–I.2, Appendix C). No tritium was detected in any samples and the required LLD was met.

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Table C–I.3, Appendix C). No plant-produced radionuclides were detected and all required LLDs were met.

2. Drinking Water

Monthly composite samples were taken hourly at one location (CL-14). The following analyses were performed:

Gross Beta

Monthly samples were analyzed for concentrations of gross beta (Tables C–II.1, Appendix C). No gross beta was detected in any of the samples.

Tritium

Monthly samples were composited quarterly and analyzed for tritium activity (Table C–II.2, Appendix C). No tritium was detected in any samples and the required LLD was met.

Iodine-131

Monthly samples from location CL-14 were analyzed for I-131 activity (Table C-II.3, Appendix C). No I-131 was detected in any samples and the required LLD was met.

Gamma Spectrometry

Monthly samples were analyzed for gamma-emitting nuclides (Table C–II.4, Appendix C). No plant-produced radionuclides were detected and all required LLDs were met.

3. Well Water

Quarterly grab samples were collected at two locations (CL-07D and CL-12, consisting of CL-12R [a raw water sample from this well] and CL-12T [same well water, but after treatment and available for consumption]). The following analyses were performed:

Tritium

Samples from all locations were analyzed for tritium activity (Table C–III.1, Appendix C). No tritium was detected in any samples and the required LLD was met.

Gamma Spectrometry

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

4. Fish

Fish samples comprised of bluegill, carp, crappie, channel catfish, and largemouth bass were collected at two locations (CL-19 and CL-105) semiannually. The following analysis was performed:

Gamma Spectrometry

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

5. Shoreline Sediment

Aquatic shoreline sediment samples were collected at CL-07B and CL-105 semiannually. The following analysis was performed:

Gamma Spectrometry

Shoreline sediment samples were analyzed for gamma-emitting nuclides (Table C–V.1, Appendix C). No plant-produced radionuclides were detected and all required LLDs were met.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from 10 locations on a weekly basis. The 10 locations were separated into three groups: Group I represents locations within one mile of the CPS site boundary (CL-2, CL-3, CL-4, CL-6, CL-15 and CL-94); Group II represents the locations at an intermediate distance within one to five miles of CPS (CL-1, CL-7 and CL-8); and Group III represents the control location greater than five miles from CPS (CL-11). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Table C–VI.1 and C–VI.2 and Figure C–1, 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 CPS. The results from the On-Site locations (Group I) ranged from 9 to 36 E–3 pCi/m^3 with a mean of 18 E–3 pCi/m^3. The results from the Intermediate Distance location (Group II) ranged from 9 to 35 E–3 pCi/m^3 with a mean of 18 E–3 pCi/m^3. The results from the Control locations (Group III) ranged from 6 to 31 E–3 pCi/m^3 with a mean of 17 E–3 pCi/m^3. Comparison of the 2018 air particulate data with previous years' data indicate no measurable impact from the operation of CPS. In addition, a comparison of the weekly mean values for 2018 indicate no notable differences among the three groups.

Gamma Spectrometry

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

b. Airborne Iodine

Continuous air samples were collected from 10 locations (CL-1, CL-2, CL-3, CL-4, CL-6, CL-7, CL-8, CL-11, CL-15 and CL-94) and analyzed weekly for I-131 (Table C-VII.1, Appendix C). All results were less than the MDC and the required LLD was met.

2. Terrestrial

a. Milk

Samples were collected from CL-116 biweekly May through October to coincide with the grazing season, and monthly November through April. The following analyses were performed:

Iodine-131

Milk samples were analyzed for concentrations of I-131 (Table C–VIII.1, Appendix C). Iodine-131 was not detected in any of the samples. The required LLD was met.

Gamma Spectrometry

Each milk sample was analyzed for concentrations of gamma-emitting nuclides (Table C–VIII.2, Appendix C). Naturally-occurring K-40 activity was found in all samples. No plant-produced radionuclides were detected and all required LLDs were met.

b. Food Products

Broadleaf vegetation samples were collected from four locations (CL-114, CL-115, CL-117 and CL-118) monthly June through September to coincide with the harvest season. The following analysis was performed:

Gamma Spectrometry

Each food product sample was analyzed for concentrations of gamma-emitting nuclides (Table C–IX.1, Appendix C). No plant-produced radionuclides were detected and all required LLDs were met.

c. Grass

Samples were collected from four locations (CL-1, CL-2, CL-8, and CL-116) biweekly May through October. The following analysis was performed:

Gamma Spectrometry

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

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing DLRs. Fifty-four DLR locations were established around the site. Results of DLR measurements are listed in Tables C–X.1 to C–X.3, Appendix C.

A total of 215 OSLD measurements were made in 2018. The average dose from the inner ring was 19.1 mRem/quarter. The average dose from the outer ring was 19.2 mRem/quarter. The average dose from the special interest group was 18.7 mRem/quarter. The average dose from the supplemental group was 17.7 mRem/quarter. The quarterly measurements ranged from 14.6 to 24.9 mRem/quarter.

The inner ring and outer ring measurements compared well to the Control Station, CL-11, which ranged from 16.6 mRem/quarter to 17.6 mRem/quarter with an average measurement of 17.2 mRem/quarter. A comparison of the Inner Ring and Outer Ring data to the Control Location data indicate that the ambient gamma radiation levels from all the locations were comparable. The historical ambient gamma radiation data from the control location were plotted along with similar data from the Inner and Outer Ring Locations (Figure C–2, Appendix C).

D. Independent Spent Fuel Storage Installation (ISFSI)

Ambient gamma radiation levels were measured utilizing DLRs. Fifty-four DLR locations were established around the site, which encompasses the ISFSI pad. ISFSI dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur. Results of DLR measurements are listed in Tables C-X.1 to C-X.3, Appendix C.

E. Land Use Survey

The Annual Land Use Survey conducted during the growing season around the Clinton Power Station (CPS) was performed by Environmental Inc. (Midwest Labs) for Exelon to comply with Clinton's Offsite Dose Calculation Manual, section 8.0. The report to CPS was dated October, 10, 2018. The purpose of the survey was to document the nearest resident, milk-producing animal and garden of greater than 50 m^2 in each of the sixteen 22 ½ degree sectors around the site. The distance and direction of all locations from the CPS Station HVAC vent stack were positioned using Global Positioning System (GPS) technology. There were no changes required to the CPS REMP as a result of the Land Use Survey. The results of this survey are summarized below:

Distance in Kilometers from the CPS Station HVAC Vent Stack			
Sector	Residence (km)	Garden (km)	Milk Animal (km)
1 N	1.5	1.5	1.5
2 NNE	1.5	1.5	> 8
3 NE	2.1	3.5	> 8
4 ENE	2.9	4.2	4.2
5 E	1.7	1.7	> 8
6 ESE	5.1	5.3	> 8
7 SE	4.4	7.8	7.2
8 SSE	2.9	> 8	> 8
9 S	4.8	6.6	6.6
10 SSW	4.7	> 8	6.3
11 SW	1.2	> 8	> 8
12 WSW	3.6	4.3	4.3
13 W	2.0	3.2	> 8
14 WNW	2.6	2.6	> 8
15 NW	2.7	> 8	> 8
16 NNW	2.1	2.1	2.1

F. Errata Data

There was no errata data for 2018.

G. Summary of Results – Inter-Laboratory Comparison Program

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes. The PE samples supplied by Analytics Inc., Environmental Resource Associates (ERA) and Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

A. Analytics Evaluation Criteria

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

B. 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, National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (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.

C. 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, 166 out of 172 analyses performed met the specified acceptance criteria. Six analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program.

1. TBE was unable to report the February 2018 DOE MAPEP vegetation Sr-90 result due to QC failure and limited sample amount. (NCR 18-09)

2. The Analytics September 2018 milk Fe-59 result was evaluated as *Not Acceptable* (Ratio of TBE to known result at 132%). The reported value was 158 ± 17.6 pCi/L and the known value was 119 ± 19.9 pCi/L. No cause for the failure could be determined. TBE has passed 24 of the previous 27 milk cross-check results since 2012. This sample was run in duplicate on a different detector with comparable results (162 +/- 16 pCi/L). *NOTE: TBE's 4th Qtr result passed at 105%* (NCR 18-20)

3. The Analytics September milk I-131 result was evaluated as *Not Acceptable* (Ratio of TBE to known result at 143%). Due to a personnel change in the gamma prep lab, the sample was not prepped/counted in a timely manner such as to accommodate the

I-131 8-day half-life. Analysts have been made aware of the urgency for this analysis and it will be monitored more closely by QA. *NOTE: TBE's 4th Qtr result passed at 101%* (NCR 18-24)

4. The Analytics September soil Cr-51 result was evaluated as *Not Acceptable* (Ratio of TBE to known result at 131%). As with #3 above, the sample was not prepped/counted in a timely manner such as to accommodate the Cr-51 27-day half-life. The same corrective action applies here as in #3. (NCR 18-21)

5. The MAPEP November vegetation Sr-90 result of 0.338 Bq/sample was evaluated as Not Acceptable (Lower acceptable range was 0.554 Bq/sample). It appears that there has been incomplete dissolution of Sr-90 due to the composition of the MAPEP vegetation "matrix". To resolve this issue, the TBE-2018 procedure has been modified to add H_2O_2 to assist in breaking down the organic material that comprises this "matrix". This corrective action will be monitored closely by QA. (NCR 18-25).

6. The ERA October 2018 water Sr-90 sample was evaluated as *Not Acceptable*. TBE's initial reported result of 36.8 pCi/L exceeded the upper acceptance range (22.9 – 36.4 pCi/L). After reviewing the data for this sample, it was discovered that there was a typographical error at the time the results were entered at the ERA website. The correct result in LIMS of 36.2 should have been submitted instead. This result is within ERA's acceptance limits. In addition to the typo error, ERA's very stringent upper acceptance limit of 116% is not a reflection of TBE's ability to successfully perform this analysis. (NCR 18-23)

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

V. References

1. American National Standards Institute, Inc., "Performance, Testing and Procedural Specifications for Thermoluminescent Dosimetry," ANSI N545-1975.
2. Code of Federal Regulations, Title 10, Part 20 (Nuclear Regulatory Commission).
3. CPS 2014 Annual Radioactive Effluent Release Report.
4. "Environmental Radioactivity," M. Eisenbud, 1987 (E187).
5. "Natural Radon Exposure in the United States," Donald T. Oakley, U.S.

Environmental Protection Agency. ORP/SID 72-1, June 1972.

6. Federal Radiation Council Report No. 1, "Background Material for the Development of Radiation Protection Standards," May 13, 1960.

7. International Commission on Radiation Protection, Publication 2, "Report of Committee II on Permissible Dose for Internal Radiation," (1959) with 1962 Supplement issued in ICRP Publication 6; Publication 9, "Recommendations on Radiation Exposure," (1965); ICRP Publication 7 (1965), amplifying specific recommendations of Publication 26 (1977).

8. International Commission on Radiation Protection, Publication No. 39 (1984), "Principles of Limiting Exposure to the Public to Natural Sources of Radiation".

9. "Radioactivity in the Environment: Sources, Distribution and Surveillance," Ronald L. Kathren, 1984.

10. National Council on Radiation Protection and Measurements, Report No. 22, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure," (Published as National Bureau of Standards Handbook 69, issued June 1959, superseding Handbook 52).

11. National Council on Radiation Protection and Measurements, Report No. 39, "Basic Radiation Protection Criteria," January 1971.

12. National Council on Radiation Protection and Measurements, Report No. 44, "Krypton-85 in the Atmosphere – Accumulation, Biological Significance, and Control Technology," July 1975.

13. National Council on Radiation Protection and Measurements, Report No. 91, "Recommendations on Limits for Exposure to Ionizing Radiation," June 1987.

14. National Council on Radiation Protection and Measurements, Report No. 93, "Ionizing Radiation Exposure of the Population of the United States," September 1987.

15. National Research Council, 1990, Committee on Biological Effects of Ionizing Radiation (BEIR V), Board on Radiation Effects Research on Life Sciences, "The Effects of Exposure to Low Levels of Ionizing Radiation".

16. United States Nuclear Regulatory Commission, Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," Revision 1, April 1975.

17. United States Nuclear Regulatory Commission, Regulatory Guide 4.13, "Performance, Testing and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications, "Revision 1, July 1977.

18. United States Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Dose to Man from Routine Releases of Reactor

Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, "Revision 1, October 1977.

19. United States Nuclear Regulatory Commission Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

20. United States Nuclear Regulatory Commission, Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Norm Operations) – Effluent Streams and the Environment," Revision 1, February 1979.

21. Technical Specifications, Clinton Power Station, Unit No. 1, Docket No. 50-461, Office of Nuclear Reactor Regulation, 1986. Facility Operating License Number NPF-62.

22. Clinton Power Station, Updated Safety Analysis Report.

23. Clinton Power Station, Unit 1, Off-Site Dose Calculation Manual.

Intentionally left blank

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

Intentionally left blank

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE CLINTON POWER STATION, 2018

NAME OF FACILITY:	**CLINTON POWER STATION**	**DOCKET NUMBER:**	**50-461**
LOCATION OF FACILITY:	**DEWITT COUNTY IL**	**REPORTING PERIOD:**	**2018**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS 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
SURFACE WATER *(PCI/LITER)*	**I-131 (LOW LVL)**	12	**1**	<LLD	NA			0
	H-3	16	**2000**	<LLD	<LLD	-		0
	GAMMA	47						
	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
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		**60**	<LLD	<LLD	-		0
	LA-140		**15**	<LLD	<LLD	-		0
	CE-144		**NA**	<LLD	<LLD	-		0
DRINKING WATER *(PCI/LITER)*	**GR-B**	12	**4**	<LLD	*NA*	-		0
	H-3	4	**2000**	<LLD	*NA*	-		0
	I-131 (LOW LVL)	12	**1**	<LLD	*NA*	-		0
	GAMMA	12						
	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
	CS-134		**15**	<LLD	*NA*	-		0
	CS-137		**18**	<LLD	*NA*	-		0
	BA-140		**60**	<LLD	*NA*	-		0
	LA-140		**15**	<LLD	*NA*	-		0
	CE-144		*NA*	<LLD	*NA*	-		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 THE CLINTON POWER STATION, 2018

NAME OF FACILITY:	**CLINTON POWER STATION**	**DOCKET NUMBER:**	**50-461**
LOCATION OF FACILITY:	**DEWITT COUNTY IL**	**REPORTING PERIOD:**	**2018**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS 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
WELL WATER *(PCI/LITER)*	**H-3**	12	**2000**	<LLD	*NA*	-		0
	GAMMA	12						
	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
	CS-134		**15**	<LLD	*NA*	-		0
	CS-137		**18**	<LLD	*NA*	-		0
	BA-140		**60**	<LLD	*NA*	-		0
	LA-140		**15**	<LLD	*NA*	-		0
	CE-144		*NA*	<LLD	*NA*	-		0
FISH *(PCI/KG WET)*	**GAMMA**	16						
	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
	CE-144		*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 THE CLINTON POWER STATION, 2018

NAME OF FACILITY:	CLINTON POWER STATION	DOCKET NUMBER:	50-461
LOCATION OF FACILITY:	DEWITT COUNTY IL	REPORTING PERIOD:	2018

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS 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
SEDIMENT	**GAMMA**	4						
(PCI/KG DRY)	*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**	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
	CE-144		*NA*	<LLD	<LLD	-		0
AIR PARTICULATE	**GR-B**	510	**10**	18	17	18	CL-3 INDICATOR	0
(E-3 PCI/CU.METER)				(459/459)	(51/51)	(51/51)	CLINTON'S SECONDARY ACCESS ROAD	
				(9/36)	*(6/31)*	*(9/34)*	0.7 MILES NE OF SITE	
	GAMMA	40						
	CO-60		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	RU-103		*NA*	<LLD	<LLD	-		0
	RU-106		*NA*	<LLD	<LLD	-		0
	CS-134		**50**	<LLD	<LLD	-		0
	CS-137		**60**	<LLD	<LLD	-		0
	CE-141		*NA*	<LLD	<LLD	-		0
	CE-144		*NA*	<LLD	<LLD	-		0
AIR IODINE	**GAMMA**	510						
(E-3 PCI/CU.METER)	*I-131*		**70**	<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 THE CLINTON POWER STATION, 2018

NAME OF FACILITY:	**CLINTON POWER STATION**			**DOCKET NUMBER:**	**50-461**			
LOCATION OF FACILITY:	**DEWITT COUNTY IL**			**REPORTING PERIOD:**	**2018**			

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS 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
MILK *(PCI/LITER)*	**I-131 (LOW LVL)**	19	**1**	*NA*	<LLD	-		0
	GAMMA	19						
	K-40		*NA*	*NA*	1129 (19/19) (790/1333)	1129 (19/19) (790/1333)	CL-116 CONTROL Dement Dairy 14 MILES WSW OF SITE	0
	MN-54		*NA*	*NA*	<LLD	-		0
	CO-58		*NA*	*NA*	<LLD	-		0
	FE-59		*NA*	*NA*	<LLD	-		0
	CO-60		*NA*	*NA*	<LLD	-		0
	ZN-65		*NA*	*NA*	<LLD	-		0
	NB-95		*NA*	*NA*	<LLD	-		0
	ZR-95		*NA*	*NA*	<LLD	-		0
	CS-134		**15**	*NA*	<LLD	-		0
	CS-137		**18**	*NA*	<LLD	-		0
	BA-140		**60**	*NA*	<LLD	-		0
	LA-140		**15**	*NA*	<LLD	-		0
	CE-144		*NA*	*NA*	<LLD	-		0
VEGETATION *(PCI/KG WET)*	**GAMMA**	28						
	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	-		0
	CE-144		*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 THE CLINTON POWER STATION, 2018

NAME OF FACILITY:	**CLINTON POWER STATION**	**DOCKET NUMBER:**	**50-461**
LOCATION OF FACILITY:	**DEWITT COUNTY IL**	**REPORTING PERIOD:**	**2018**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS 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
GRASS	**GAMMA**	52						
(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	-		0
	CE-144		*NA*	<LLD	<LLD	-		0
DIRECT RADIATION *(MILLI-ROENTGEN/QTR.)*	**OSLD-QUARTERLY**	215	*NA*	18.7 (211/211) *(14.6/24.9)*	17.2 (4/4) *(16.6/17.6)*	21.2 (4/4) *(19.7/24.9)*	CL-43 INDICATOR 2.8 MILES SE	0

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

Intentionally left blank

APPENDIX B

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

Intentionally left blank

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction
Clinton Power Station, 2018

Location	Location Description	Distance & Direction From Site
A. Surface Water		
CL-13	Salt Creek Bridge on Rt. 10 (indicator)	3.6 miles SW
CL-90	Discharge Flume (indicator)	0.4 miles SE
CL-91	Parnell Boat Access (control)	6.1 miles ENE
CL-99	North Fork Access (control)	3.5 miles NNE
B. Drinking (Potable) Water		
CL-14	Station Plant Service Bldg (indicator)	Onsite
C. Well Water		
CL-7D	Mascoutin Recreation Area (indicator)	2.3 miles ESE
CL-12T	DeWitt Pump House (indicator)	1.6 miles E
CL-12R	DeWitt Pump House (indicator)	1.6 miles E
D. Milk - bi-weekly / monthly		
CL-116	Dement Dairy (control)	14 miles WSW
E. Air Particulates / Air Iodine		
CL-1	Camp Quest	1.8 miles W
CL-2	Clinton's Main Access Road	0.7 miles NNE
CL-3	Clinton's Secondary Access Road	0.7 miles NE
CL-4	Residence Near Recreation Area	0.8 miles SW
CL-6	Clinton's Recreation Area	0.7 miles WSW
CL-7	Mascoutin Recreation Area	2.3 miles SE
CL-8	DeWitt Cemetery	2.2 miles E
CL-11	Illinois Power Substation (control)	16 miles S
CL-15	Rt. 900N Residence	0.9 miles N
CL-94	Old Clinton Road	0.6 miles E
F. Fish		
CL-19	End of Discharge Flume (indicator)	3.4 miles E
CL-105	Lake Shelbyville (control)	50 miles S
G. Shoreline Sediment		
CL-7B	Clinton Lake (indicator)	2.1 miles SE
CL-105	Lake Shelbyville (control)	50 miles S
H. Food Products		
CL-114	Residence SSE of Site (Control)	12.5 miles SSE
CL-115	Site's Secondary Access Road	0.7 miles NE
CL-117	Residence North of Site	0.9 miles N
CL-118	Site's Main Access Road	0.7 miles NNE
I. Grass		
CL-1	Camp Quest	1.8 miles W
CL-2	Clinton's Main Access Road	0.7 miles NNE
CL-8	DeWitt Cemetery	2.2 miles E
CL-116	Pasture in Rural Kenney (control)	14 miles WSW

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction
Clinton Power Station, 2018

Location	Location Description	Distance & Direction From Site
J. Environmental Dosimetry - DLR		
Inner Ring		
CL-1		1.8 miles W
CL-5		0.7 miles NNE
CL-22		0.6 miles NE
CL-23		0.5 miles ENE
CL-24		0.5 miles E
CL-34		0.8 miles WNW
CL-35		0.7 miles NW
CL-36		0.6 miles N
CL-42		2.8 miles ESE
CL-43		2.8 miles SE
CL-44		2.3 miles SSE
CL-45		2.8 miles S
CL-46		2.8 miles SSW
CL-47		3.3 miles SW
CL-48		2.3 miles WSW
CL-63		1.3 miles NNW
Outer Ring		
CL-51		4.4 miles NW
CL-52		4.3 miles NNW
CL-53		4.3 miles E
CL-54		4.6 miles ESE
CL-55		4.1 miles SE
CL-56		4.1 miles SSE
CL-57		4.6 miles S
CL-58		4.3 miles SSW
CL-60		4.5 miles SW
CL-61		4.5 miles WSW
CL-76		4.6 miles N
CL-77		4.5 miles NNE
CL-78		4.8 miles NE
CL-79		4.5 miles ENE
CL-80		4.1 miles W
CL-81		4.5 miles WNW
Special Interest		
CL-37		3.4 miles N
CL-41		2.4 miles E
CL-49		3.5 miles W
CL-64		2.1 miles WNW
CL-65		2.6 miles ENE
CL-74		1.9 miles W
CL-75		0.9 miles N

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction
Clinton Power Station, 2018

Location	Location Description	Distance & Direction From Site
J. Environmental Dosimetry – DLR (cont.)		
Supplemental		
CL-2		0.7 miles NNE
CL-3		0.7 miles NE
CL-4		0.8 miles SW
CL-6		0.8 miles WSW
CL-7		2.3 miles SE
CL-8		2.2 miles E
CL-15		0.9 miles N
CL-33		11.7 miles SW
CL-84		0.6 miles E
CL-90		0.4 miles SE
CL-91		6.1 miles ENE
CL-97		10.3 miles SW
CL-99		3.5 miles NNE
CL-114		12.5 miles SE
Control		
CL-11		16 miles S

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Clinton Power Station, 2018

Sample Medium	Analysis	Sampling Method	Analytical Procedure Number
Surface Water	Gamma Spectroscopy	Monthly composite from a continuous water compositor	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Surface Water	Tritium	Quarterly composite from a continuous water compositor	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., SPM-1 Sampling Procedure Manual
Surface Water	I-131	Monthly composite from a continuous water compositor	TBE, TBE-2012 Radioiodine in various matrices Env. Inc., SPM-1 Sampling Procedure Manual
Drinking Water	Gross Beta	Monthly composite from a continuous water compositor	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., SPM-1 Sampling Procedure Manual
Drinking Water	Gamma Spectroscopy	Monthly composite from a continuous water compositor	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Drinking Water	Tritium	Quarterly composite from a continuous water compositor	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., SPM-1 Sampling Procedure Manual
Drinking Water	I-131	Monthly composite from a continuous water compositor	TBE, TBE-2031 Radioactive Iodine in Drinking Water Env. Inc., SPM-1 Sampling Procedure Manual
Well Water	Gamma Spectroscopy	Quarterly composite from a continuous water compositor	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Well Water	Tritium	Quarterly composite from a continuous water compositor	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., SPM-1 Sampling Procedure Manual
Fish	Gamma Spectroscopy	Semi-annual samples collected via electroshocking or other techniques	TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Sediment	Gamma Spectroscopy	Semi-annual grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
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 Env. Inc., SPM-1 Sampling Procedure Manual
Air Particulates	Gamma Spectroscopy	Quarterly composite of each station	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Air Iodine	Gamma Spectroscopy	One-week composite of continuous air sampling through charcoal filter	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Milk	I-131	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE, TBE-2012 Radioiodine in various matrices Env. Inc., SPM-1 Sampling Procedure Manual

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Clinton Power Station, 2018

Sample Medium	Analysis	Sampling Method	Analytical Procedure Number
Milk	Gamma Spectroscopy	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE-2007 Gamma emitting radioisotope analysis Env. Inc., SPM-1 Sampling Procedure Manual
Food Products	Gross Beta	Monthly grab June through September	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., SPM-1 Sampling Procedure Manual
Food Products	Gamma Spectroscopy	Monthly grab June through September	TBE, TBE-2007 Gamma emitting radioisotopes analysis Env. Inc., SPM-1 Sampling Procedure Manual
Grass	Gamma Spectroscopy	Biweekly May through October	TBE, TBE-2007 Gamma emitting radioisotopes analysis Env. Inc., SPM-1 Sampling Procedure Manual
DLR	Thermo-Luminescence Dosimetry	Quarterly DLRs comprised of two Al_2O_3:C Landauer Incorporated elements	Landauer Incorporated

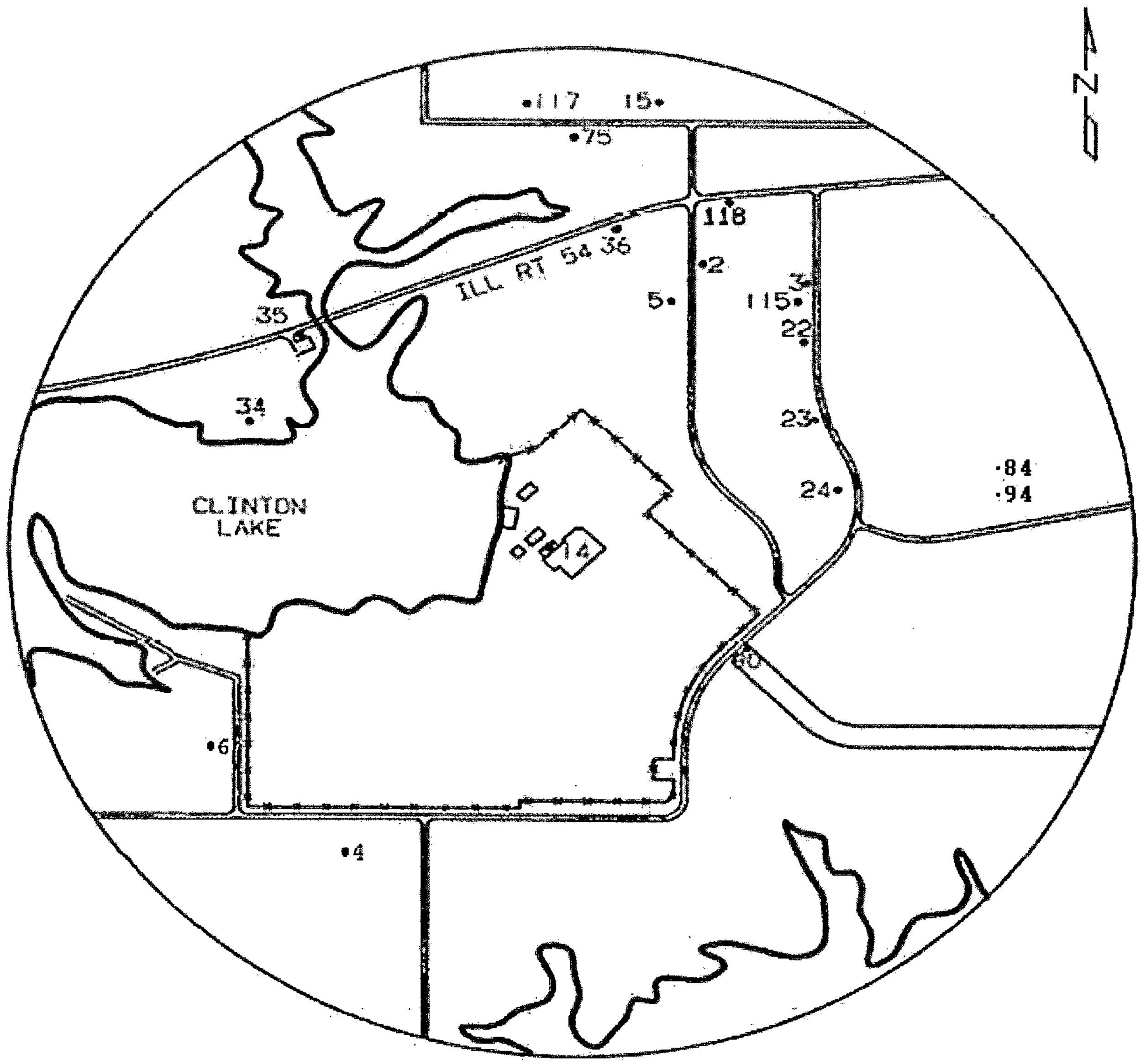


Figure B-1
Environmental Sampling Locations Within One
Mile of the Clinton Power Station, 2018

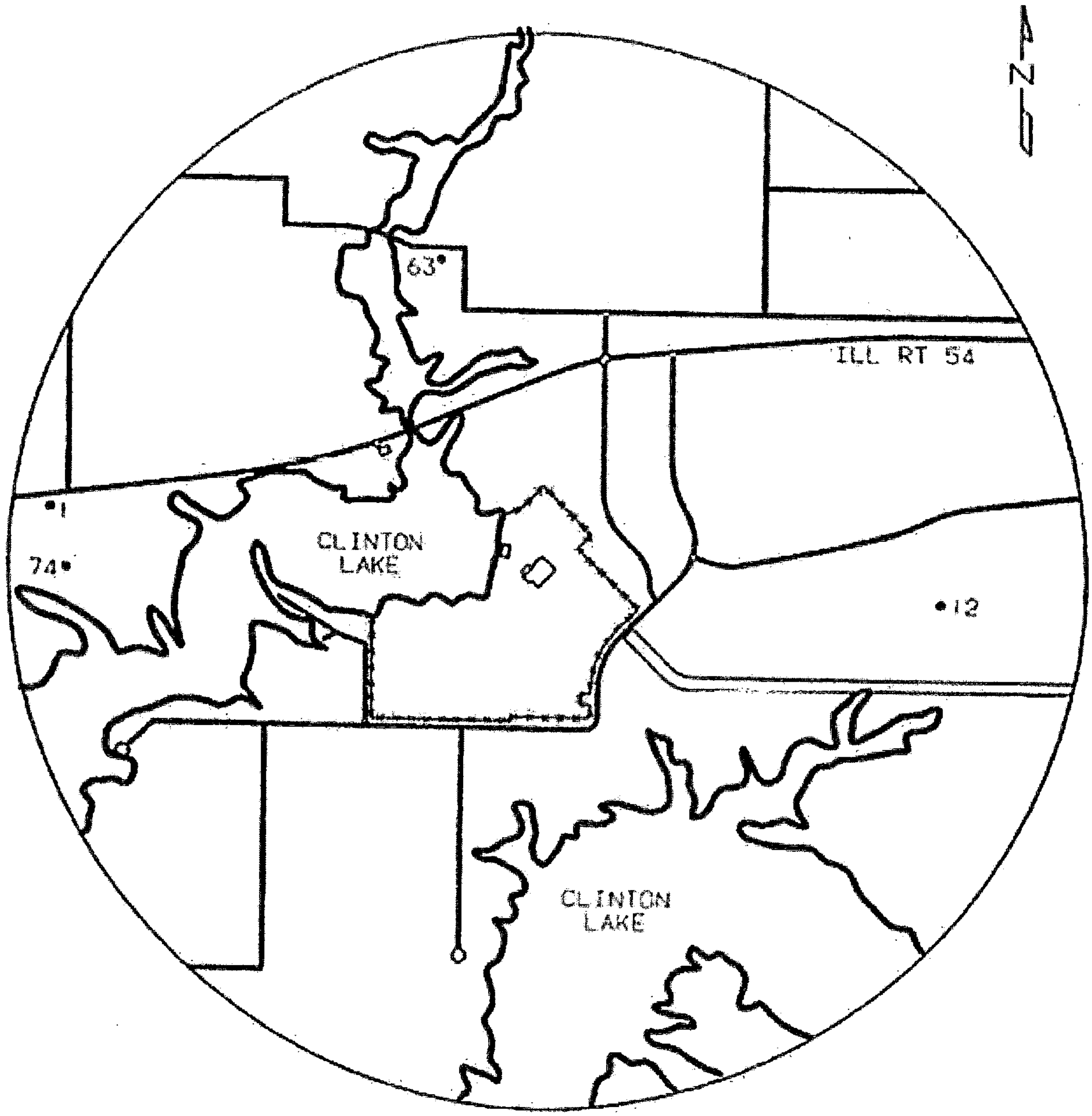


Figure B-2
Environmental Sampling Locations Between One and Two
Miles of the Clinton Power Station, 2018

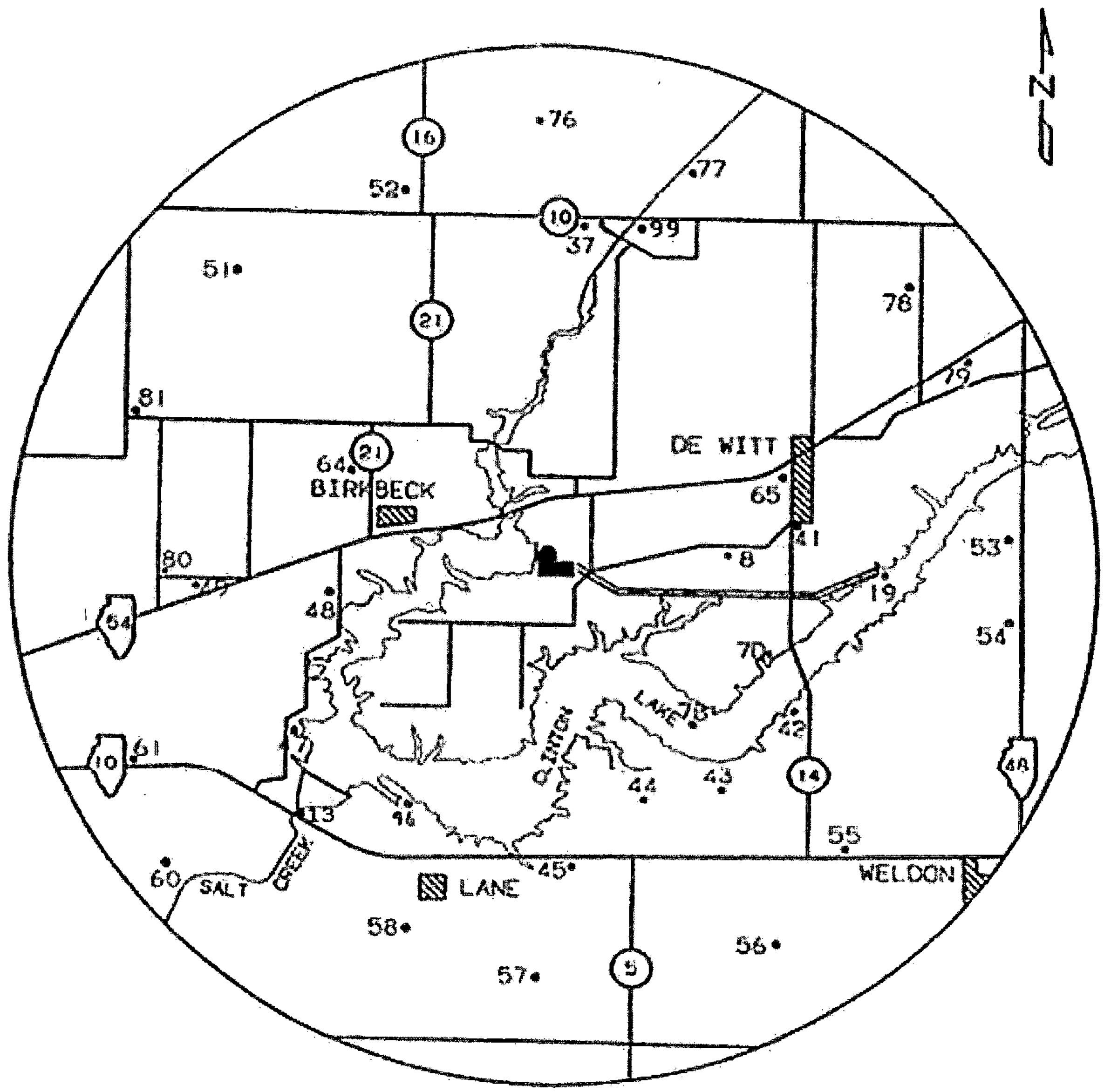


Figure B-3
Environmental Sampling Locations between Two and Five Miles from the Clinton Power Station, 2018

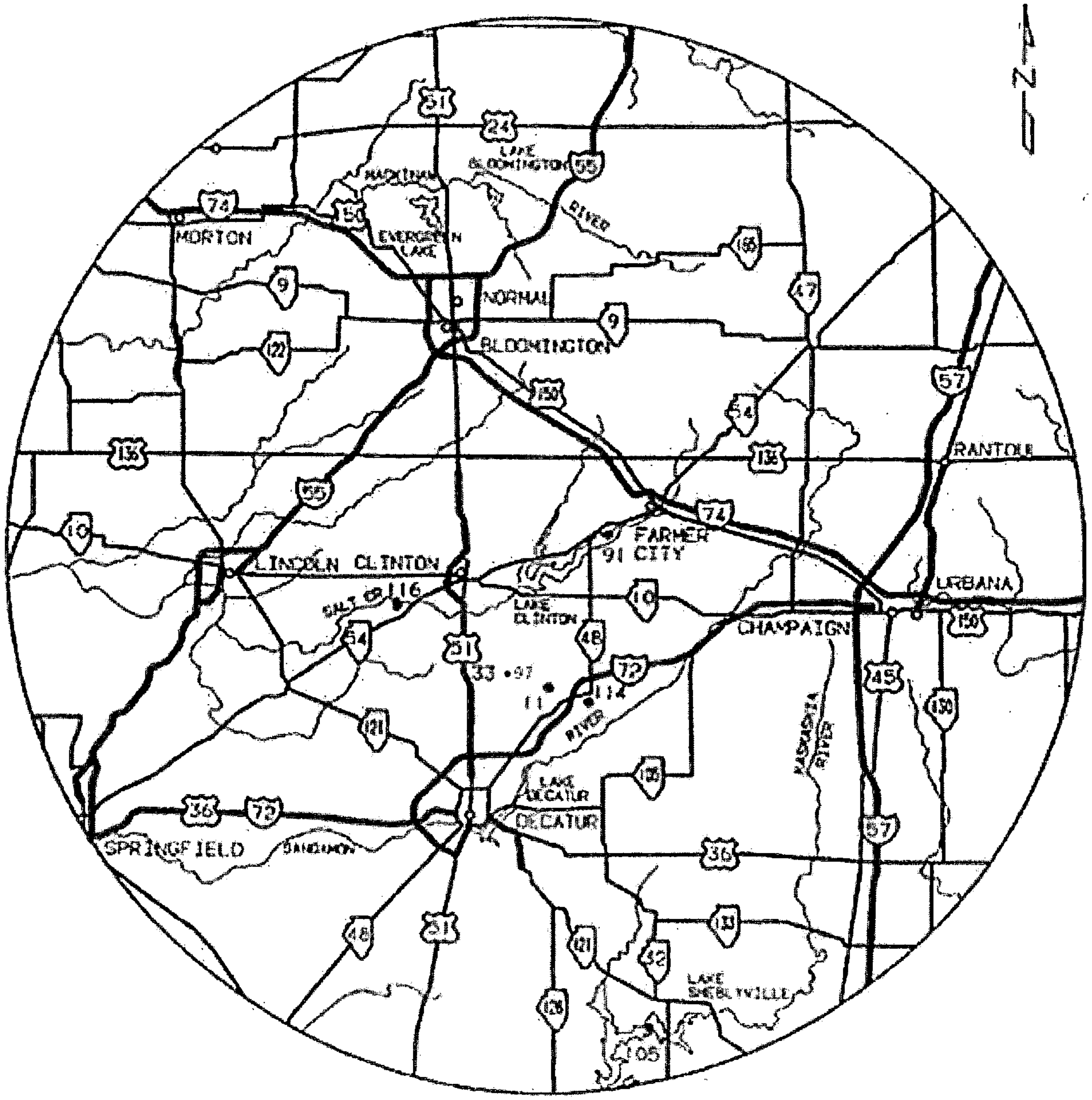


Figure B-4
Environmental Sampling Locations Greater Than Five
Miles of the Clinton Power Station, 2018

Intentionally left blank

APPENDIX C

DATA TABLES AND FIGURES

Intentionally Left Blank

Table C-I.1 **CONCENTRATIONS OF I-131 IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-90
01/10/18 - 01/31/18	< 0.4
01/31/18 - 02/28/18	< 0.3
02/28/18 - 03/28/18	< 0.7
03/28/18 - 04/25/18	< 0.6
04/25/18 - 05/30/18	< 0.8
05/30/18 - 06/27/18	< 0.6
06/27/18 - 07/25/18	< 0.5
07/25/18 - 08/29/18	< 0.8
08/29/18 - 09/26/18	< 0.5
09/26/18 - 10/31/18	< 0.6
10/31/18 - 11/28/18	< 1.0
11/28/18 - 12/26/18	< 0.6
MEAN	-

Table C-I.2 **CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-13	CL-90	CL-91	CL-99
12/27/17 - 03/28/18	< 187	< 191	< 188	< 184
04/25/18 - 06/27/18	< 192	< 196	< 196	< 192
07/25/18 - 09/26/18	< 191	< 190	< 194	< 195
10/31/18 - 12/26/18	< 189	< 191	< 192	< 189
MEAN	-	-	-	-

Table C-I.3

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-13	01/31/18 - 01/31/18	< 6	< 7	< 14	< 5	< 10	< 8	< 9	< 7	< 7	< 28	< 8	< 45
	02/28/18 - 02/28/18	< 8	< 8	< 18	< 8	< 19	< 8	< 15	< 8	< 8	< 34	< 14	< 45
	03/28/18 - 03/28/18	< 9	< 10	< 21	< 10	< 21	< 10	< 16	< 8	< 8	< 37	< 14	< 53
	04/25/18 - 04/25/18	< 6	< 8	< 15	< 8	< 16	< 7	< 12	< 8	< 8	< 33	< 10	< 51
	05/30/18 - 05/30/18	< 3	< 3	< 7	< 3	< 7	< 3	< 5	< 3	< 3	< 21	< 7	< 22
	06/27/18 - 06/27/18	< 4	< 4	< 8	< 4	< 9	< 4	< 7	< 4	< 4	< 17	< 5	< 30
	07/25/18 - 07/25/18	< 7	< 6	< 14	< 6	< 10	< 7	< 10	< 7	< 7	< 31	< 8	< 58
	08/29/18 - 08/29/18	< 6	< 6	< 9	< 5	< 13	< 8	< 11	< 6	< 5	< 27	< 11	< 49
	09/26/18 - 09/26/18	< 7	< 5	< 10	< 6	< 12	< 7	< 10	< 8	< 7	< 32	< 8	< 51
	10/31/18 - 10/31/18	< 9	< 8	< 14	< 7	< 13	< 7	< 12	< 10	< 8	< 37	< 12	< 57
	11/28/18 - 11/28/18	< 5	< 5	< 9	< 5	< 10	< 5	< 10	< 6	< 5	< 33	< 7	< 36
	12/26/18 - 12/26/18	< 6	< 6	< 10	< 8	< 10	< 5	< 8	< 5	< 6	< 29	< 8	< 34
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
CL-90	01/10/18 - 01/31/18 *(1)*	< 8	< 6	< 10	< 7	< 13	< 7	< 10	< 7	< 7	< 28	< 8	< 50
	01/31/18 - 02/28/18	< 6	< 6	< 13	< 8	< 9	< 7	< 11	< 9	< 7	< 27	< 9	< 45
	02/28/18 - 03/28/18	< 8	< 8	< 17	< 7	< 18	< 8	< 13	< 11	< 10	< 41	< 15	< 51
	03/28/18 - 04/25/18	< 4	< 3	< 7	< 5	< 6	< 4	< 7	< 4	< 4	< 19	< 7	< 29
	04/25/18 - 05/30/18	< 3	< 3	< 8	< 4	< 6	< 4	< 7	< 3	< 3	< 20	< 8	< 18
	05/30/18 - 06/27/18	< 4	< 4	< 10	< 5	< 10	< 4	< 7	< 4	< 5	< 19	< 5	< 32
	06/27/18 - 07/25/18	< 8	< 7	< 11	< 7	< 12	< 6	< 12	< 9	< 7	< 34	< 11	< 61
	07/25/18 - 08/29/18	< 7	< 7	< 15	< 8	< 15	< 9	< 14	< 8	< 6	< 38	< 14	< 47
	08/29/18 - 09/26/18	< 5	< 6	< 16	< 6	< 16	< 8	< 11	< 7	< 7	< 31	< 14	< 50
	09/26/18 - 10/31/18	< 7	< 4	< 12	< 7	< 12	< 6	< 8	< 7	< 6	< 26	< 12	< 40
	10/31/18 - 11/28/18	< 4	< 5	< 11	< 4	< 10	< 5	< 9	< 6	< 5	< 34	< 14	< 37
	11/28/18 - 12/26/18	< 7	< 6	< 13	< 7	< 12	< 7	< 10	< 7	< 7	< 35	< 12	< 37
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-I.3 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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	Ce-144
CL-91	12/27/17 - 01/13/18		< 5	< 8	< 14	< 8	< 14	< 8	< 14	< 9	< 7	< 37	< 14	< 64
	01/31/18 - 02/28/18		< 6	< 5	< 12	< 5	< 10	< 5	< 9	< 6	< 6	< 23	< 9	< 42
	02/28/18 - 03/28/18		< 6	< 7	< 14	< 8	< 13	< 6	< 12	< 6	< 7	< 26	< 6	< 58
	03/28/18 - 04/25/18		< 4	< 4	< 9	< 4	< 7	< 5	< 8	< 4	< 4	< 18	< 3	< 33
	04/25/18 - 05/30/18		< 3	< 3	< 6	< 3	< 5	< 3	< 5	< 3	< 3	< 18	< 6	< 24
	05/30/18 - 06/27/18		< 5	< 5	< 12	< 6	< 11	< 5	< 9	< 5	< 6	< 27	< 9	< 47
	06/27/18 - 07/25/18		< 6	< 6	< 12	< 7	< 12	< 7	< 10	< 6	< 6	< 29	< 7	< 43
	07/25/18 - 08/29/18		< 6	< 7	< 15	< 7	< 16	< 7	< 12	< 7	< 6	< 32	< 10	< 49
	08/29/18 - 09/26/18		< 8	< 9	< 17	< 9	< 11	< 8	< 10	< 9	< 8	< 38	< 11	< 53
	09/26/18 - 10/31/18		< 7	< 6	< 15	< 7	< 15	< 5	< 11	< 6	< 6	< 34	< 10	< 41
	10/31/18 - 11/28/18		< 3	< 5	< 9	< 5	< 7	< 5	< 7	< 4	< 5	< 28	< 8	< 36
	11/28/18 - 12/26/18		< 6	< 7	< 15	< 6	< 14	< 7	< 10	< 8	< 8	< 30	< 15	< 43
	MEAN		-	-	-	-	-	-	-	-	-	-	-	-
CL-99	12/27/17 - 01/31/18	*(1)*												
	01/31/18 - 02/28/18		< 8	< 8	< 15	< 10	< 21	< 8	< 15	< 9	< 10	< 38	< 11	< 77
	02/28/18 - 03/28/18		< 6	< 8	< 22	< 8	< 13	< 5	< 14	< 5	< 9	< 35	< 11	< 55
	03/28/18 - 04/25/18		< 7	< 6	< 16	< 5	< 12	< 6	< 9	< 7	< 7	< 31	< 10	< 34
	04/25/18 - 05/30/18		< 2	< 2	< 5	< 2	< 4	< 3	< 4	< 3	< 2	< 14	< 5	< 18
	05/30/18 - 06/27/18		< 4	< 5	< 8	< 5	< 9	< 4	< 8	< 4	< 4	< 18	< 7	< 28
	06/27/18 - 07/25/18		< 8	< 7	< 14	< 8	< 18	< 8	< 12	< 7	< 8	< 31	< 12	< 59
	07/25/18 - 08/29/18		< 6	< 5	< 14	< 6	< 11	< 6	< 12	< 7	< 6	< 30	< 10	< 45
	08/29/18 - 09/26/18		< 3	< 5	< 13	< 6	< 12	< 7	< 9	< 5	< 5	< 31	< 10	< 36
	09/26/18 - 10/31/18		< 7	< 8	< 18	< 7	< 19	< 8	< 13	< 9	< 8	< 40	< 8	< 56
	10/31/18 - 11/28/18		< 4	< 5	< 11	< 5	< 8	< 5	< 7	< 5	< 4	< 34	< 10	< 34
	11/28/18 - 12/26/18		< 5	< 6	< 14	< 7	< 11	< 5	< 11	< 7	< 6	< 28	< 11	< 40
	MEAN		-	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.1 **CONCENTRATIONS OF GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-14
12/27/17 - 01/31/18	< 1.6
01/31/18 - 02/28/18	< 1.8
02/28/18 - 03/28/18	< 1.9
03/28/18 - 04/25/18	< 1.5
04/25/18 - 05/30/18	< 1.6
05/30/18 - 06/27/18	< 1.6
06/27/18 - 07/25/18	< 1.6
07/25/18 - 08/29/18	< 1.6
08/29/18 - 09/26/18	< 1.3
09/26/18 - 10/31/18	< 1.6
10/31/18 - 11/28/18	< 1.7
11/28/18 - 12/26/18	< 1.6
MEAN	-

Table C-II.2 **CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-14
12/27/17 - 03/28/18	< 187
03/28/18 - 06/27/18	< 165
06/27/18 - 09/26/18	< 194
09/26/18 - 12/26/18	< 190
MEAN	-

Table C-II.3 **CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-14
12/27/17 - 01/31/18	< 0.3
01/31/18 - 02/28/18	< 0.3
02/28/18 - 03/28/18	< 0.9
03/28/18 - 04/25/18	< 0.6
04/25/18 - 05/30/18	< 0.7
05/30/18 - 06/27/18	< 0.6
06/27/18 - 07/25/18	< 0.7
07/25/18 - 08/29/18	< 0.7
08/29/18 - 09/26/18	< 0.5
09/26/18 - 10/31/18	< 0.6
10/31/18 - 11/28/18	< 0.8
11/28/18 - 12/26/18	< 0.6
MEAN	-

Table C-II.4

CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-14	12/27/17 - 01/31/18	< 8	< 9	< 19	< 6	< 14	< 8	< 14	< 9	< 8	< 29	< 14	< 50
	01/31/18 - 02/28/18	< 7	< 8	< 14	< 9	< 17	< 7	< 12	< 8	< 8	< 34	< 14	< 52
	02/28/18 - 03/28/18	< 8	< 7	< 15	< 9	< 14	< 8	< 14	< 9	< 8	< 29	< 12	< 61
	03/28/18 - 04/25/18	< 4	< 3	< 7	< 3	< 8	< 5	< 6	< 4	< 4	< 16	< 6	< 29
	04/25/18 - 05/30/18	< 3	< 4	< 8	< 4	< 7	< 4	< 6	< 4	< 3	< 20	< 6	< 25
	05/30/18 - 06/27/18	< 5	< 5	< 8	< 6	< 9	< 5	< 11	< 6	< 6	< 23	< 9	< 40
	06/27/18 - 07/25/18	< 7	< 7	< 14	< 7	< 15	< 7	< 13	< 8	< 7	< 27	< 11	< 51
	07/25/18 - 08/29/18	< 6	< 7	< 13	< 8	< 15	< 8	< 11	< 8	< 7	< 33	< 8	< 52
	08/29/18 - 09/26/18	< 8	< 7	< 15	< 6	< 17	< 7	< 15	< 8	< 7	< 37	< 13	< 55
	09/26/18 - 10/31/18	< 7	< 7	< 13	< 7	< 11	< 7	< 10	< 6	< 8	< 31	< 10	< 47
	10/31/18 - 11/28/18	< 4	< 5	< 10	< 5	< 8	< 5	< 8	< 4	< 4	< 28	< 11	< 34
	11/28/18 - 12/26/18	< 7	< 5	< 12	< 6	< 11	< 8	< 13	< 9	< 6	< 32	< 12	< 43
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1 **CONCENTRATIONS OF TRITIUM IN WELL WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CL-07D	CL-12R	CL-12T
03/28/18 - 03/28/18	< 179	< 180	< 177
06/27/18 - 06/27/18	< 178	< 180	< 179
09/26/18 - 09/26/18	< 191	< 192	< 191
12/26/18 - 12/26/18	< 193	< 186	< 188
MEAN	-	-	-

Table C-III.2

CONCENTRATIONS OF GAMMA EMITTERS IN WELL WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-07D	03/28/18	< 8	< 8	< 14	< 10	< 11	< 10	< 13	< 9	< 8	< 32	< 9	< 66
	06/27/18	< 7	< 4	< 10	< 6	< 13	< 6	< 12	< 8	< 6	< 31	< 11	< 43
	09/26/18	< 7	< 5	< 13	< 7	< 16	< 9	< 13	< 8	< 7	< 38	< 12	< 60
	12/26/18	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 16	< 5	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
CL-12R	03/28/18	< 5	< 6	< 12	< 7	< 11	< 6	< 10	< 8	< 7	< 27	< 9	< 46
	06/27/18	< 5	< 7	< 11	< 6	< 13	< 5	< 10	< 6	< 7	< 31	< 10	< 34
	09/26/18	< 6	< 8	< 12	< 6	< 15	< 9	< 12	< 6	< 8	< 35	< 10	< 52
	12/26/18	< 6	< 7	< 14	< 8	< 12	< 5	< 11	< 6	< 4	< 28	< 10	< 45
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
CL-12T	03/28/18	< 7	< 6	< 12	< 6	< 13	< 6	< 10	< 7	< 6	< 28	< 7	< 52
	06/27/18	< 7	< 5	< 15	< 5	< 15	< 6	< 14	< 7	< 7	< 34	< 9	< 46
	09/26/18	< 6	< 6	< 14	< 8	< 15	< 8	< 12	< 10	< 8	< 34	< 14	< 48
	12/26/18	< 6	< 6	< 10	< 7	< 14	< 6	< 11	< 7	< 6	< 27	< 12	< 46
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-IV.1

CONCENTRATIONS OF GAMMA EMITTERS IN FISH SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Cs-134	Cs-137	Ba-140	La-140	Ce-144
CL-19													
Bluegill	04/24/18	< 37	< 41	< 95	< 46	< 103	< 53	< 79	< 50	< 45	< 235	< 53	< 268
Carp	04/24/18	< 89	< 86	< 159	< 93	< 210	< 90	< 128	< 94	< 83	< 410	< 138	< 419
Channel Catfish	04/24/18	< 75	< 78	< 151	< 71	< 185	< 87	< 162	< 71	< 92	< 449	< 172	< 435
Largemouth Bass	04/24/18	< 57	< 46	< 95	< 76	< 104	< 64	< 100	< 58	< 54	< 292	< 87	< 328
Bluegill	10/01/18	< 68	< 77	< 125	< 68	< 136	< 73	< 133	< 71	< 70	< 423	< 90	< 352
Carp	10/01/18	< 76	< 69	< 148	< 69	< 150	< 69	< 122	< 79	< 73	< 385	< 124	< 429
Channel Catfish	10/01/18	< 44	< 35	< 83	< 36	< 105	< 44	< 79	< 43	< 40	< 206	< 72	< 220
Largemouth Bass	10/01/18	< 50	< 50	< 84	< 41	< 89	< 56	< 56	< 45	< 40	< 243	< 53	< 225
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
CL-105													
Carp	04/24/18	< 78	< 69	< 145	< 67	< 146	< 71	< 137	< 74	< 81	< 355	< 155	< 273
Largemouth Bass	04/24/18	< 78	< 76	< 183	< 95	< 193	< 87	< 152	< 83	< 89	< 408	< 93	< 430
Bluegill	05/02/18	< 61	< 51	< 106	< 89	< 140	< 64	< 109	< 63	< 62	< 306	< 79	< 292
Crappie	05/02/18	< 38	< 37	< 83	< 38	< 58	< 43	< 58	< 37	< 43	< 198	< 76	< 222
Bluegill	10/01/18	< 65	< 73	< 137	< 63	< 163	< 82	< 99	< 67	< 76	< 355	< 75	< 353
Carp	10/01/18	< 50	< 40	< 86	< 38	< 90	< 47	< 75	< 44	< 34	< 214	< 64	< 242
Crappie/White Bass	10/01/18	< 36	< 29	< 82	< 46	< 72	< 45	< 64	< 34	< 40	< 210	< 65	< 210
Largemouth Bass	10/01/18	< 68	< 59	< 119	< 63	< 135	< 54	< 95	< 56	< 51	< 373	< 90	< 364
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-V.1

CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/KG DRY + 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	Ce-144
CL-07B	04/24/18	< 93	< 87	< 122	< 58	< 176	< 95	< 160	< 99	< 85	< 614	< 168	< 464
	10/01/18	< 56	< 55	< 113	< 64	< 99	< 49	< 90	< 63	< 50	< 282	< 67	< 281
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
CL-105	04/24/18	< 52	< 51	< 163	< 53	< 102	< 56	< 93	< 73	< 59	< 418	< 74	< 309
	10/01/18	< 44	< 44	< 101	< 43	< 97	< 44	< 78	< 48	< 47	< 202	< 76	< 216
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-VI.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

COLLECTION PERIOD	GROUP I					
	CL-2	CL-3	CL-4	CL-6	CL-15	CL-94
01/03/18 - 01/10/18	31 ± 5	34 ± 5	28 ± 5	30 ± 5	36 ± 5	31 ± 5
01/10/18 - 01/17/18	19 ± 4	16 ± 4	16 ± 4	17 ± 4	18 ± 4	15 ± 4
01/17/18 - 01/24/18	20 ± 4	19 ± 4	22 ± 5	16 ± 4	18 ± 4	16 ± 4
01/24/18 - 01/31/18	12 ± 4	12 ± 4	15 ± 4	14 ± 4	11 ± 4	14 ± 4
01/31/18 - 02/07/18	15 ± 4	19 ± 5	15 ± 4	15 ± 4	17 ± 5	16 ± 4
02/07/18 - 02/14/18	28 ± 5	31 ± 5	27 ± 5	29 ± 5	32 ± 5	26 ± 5
02/14/18 - 02/21/18	15 ± 4	22 ± 5	17 ± 4	16 ± 4	19 ± 4	21 ± 5
02/21/18 - 02/28/18	13 ± 4	16 ± 4	13 ± 4	15 ± 4	12 ± 4	15 ± 4
02/28/18 - 03/07/18	16 ± 4	18 ± 4	14 ± 4	17 ± 4	15 ± 4	13 ± 4
03/07/18 - 03/14/18	16 ± 4	18 ± 5	17 ± 4	14 ± 4	17 ± 4	17 ± 4
03/14/18 - 03/21/18	14 ± 4	15 ± 4	15 ± 4	13 ± 4	14 ± 4	11 ± 4
03/21/18 - 03/28/18	12 ± 4	11 ± 4	13 ± 4	13 ± 4	11 ± 4	14 ± 4
03/28/18 - 04/04/18	15 ± 4	9 ± 4	14 ± 4	17 ± 5	13 ± 4	16 ± 4
04/04/18 - 04/11/18	17 ± 5	16 ± 5	20 ± 5	21 ± 5	15 ± 4	16 ± 4
04/11/18 - 04/18/18	13 ± 4	11 ± 3	13 ± 4	14 ± 4	14 ± 4	15 ± 4
04/18/18 - 04/25/18	15 ± 4	17 ± 4	10 ± 4	14 ± 4	13 ± 4	17 ± 4
04/25/18 - 05/02/18	11 ± 4	16 ± 4	12 ± 4	14 ± 4	14 ± 4	15 ± 4
05/02/18 - 05/09/18	18 ± 4	20 ± 4	20 ± 4	21 ± 4	22 ± 4	21 ± 4
05/09/18 - 05/16/18	17 ± 5	20 ± 5	20 ± 5	14 ± 5	16 ± 5	13 ± 5
05/16/18 - 05/23/18	18 ± 4	18 ± 4	19 ± 4	18 ± 4	19 ± 4	14 ± 4
05/23/18 - 05/30/18	22 ± 5	19 ± 4	21 ± 5	16 ± 4	20 ± 4	18 ± 4
05/30/18 - 06/06/18	13 ± 4	13 ± 4	14 ± 4	19 ± 4	14 ± 4	16 ± 4
06/06/18 - 06/13/18	17 ± 4	23 ± 4	18 ± 4	20 ± 4	21 ± 4	21 ± 4
06/13/18 - 06/20/18	16 ± 4	14 ± 4	13 ± 4	16 ± 4	16 ± 4	16 ± 4
06/20/18 - 06/27/18	10 ± 3	12 ± 4	10 ± 3	17 ± 4	13 ± 4	13 ± 4
06/27/18 - 07/04/18	15 ± 4	17 ± 4	15 ± 4	13 ± 4	18 ± 4	13 ± 4
07/04/18 - 07/11/18	15 ± 4	20 ± 5	12 ± 4	17 ± 4	18 ± 4	15 ± 4
07/11/18 - 07/18/18	20 ± 4	18 ± 4	16 ± 4	19 ± 4	15 ± 4	16 ± 4
07/18/18 - 07/25/18 *(1)*						
07/25/18 - 08/01/18	19 ± 4	17 ± 4	18 ± 4	20 ± 4	18 ± 4	15 ± 4
08/01/18 - 08/08/18	32 ± 5	28 ± 5	28 ± 5	29 ± 5	28 ± 5	21 ± 5
08/08/18 - 08/15/18	25 ± 5	20 ± 4	22 ± 4	23 ± 4	22 ± 4	23 ± 4
08/15/18 - 08/22/18	18 ± 4	16 ± 4	15 ± 4	19 ± 4	14 ± 4	15 ± 4
08/22/18 - 08/29/18	25 ± 4	22 ± 4	21 ± 4	25 ± 4	26 ± 5	20 ± 4
08/29/18 - 09/05/18	15 ± 4	17 ± 4	13 ± 4	16 ± 4	16 ± 4	14 ± 4
09/05/18 - 09/12/18	11 ± 4	13 ± 4	10 ± 3	12 ± 4	11 ± 4	12 ± 4
09/12/18 - 09/19/18	16 ± 4	18 ± 4	14 ± 4	19 ± 4	20 ± 4	14 ± 4
09/19/18 - 09/26/18	13 ± 4	15 ± 4	11 ± 4	14 ± 4	12 ± 4	12 ± 4
09/26/18 - 10/03/18	18 ± 4	21 ± 4	23 ± 4	24 ± 5	21 ± 4	13 ± 4
10/03/18 - 10/10/18	12 ± 4	13 ± 4	9 ± 4	13 ± 4	13 ± 4	10 ± 4
10/10/18 - 10/17/18	14 ± 4	12 ± 4	12 ± 4	13 ± 4	10 ± 3	9 ± 3
10/17/18 - 10/24/18	12 ± 4	14 ± 4	13 ± 4	12 ± 4	15 ± 4	11 ± 4
10/24/18 - 10/31/18	16 ± 4	21 ± 4	17 ± 4	19 ± 4	18 ± 4	18 ± 4
10/31/18 - 11/07/18	14 ± 4	16 ± 4	15 ± 4	14 ± 4	18 ± 4	14 ± 4
11/07/18 - 11/14/18	21 ± 4	17 ± 4	16 ± 4	17 ± 4	16 ± 4	18 ± 4
11/14/18 - 11/21/18	23 ± 5	21 ± 4	21 ± 4	26 ± 5	24 ± 5	21 ± 4
11/21/18 - 11/28/18	31 ± 5	34 ± 5	30 ± 5	30 ± 5	30 ± 5	30 ± 5
11/28/18 - 12/05/18	13 ± 4	17 ± 4	15 ± 4	17 ± 4	16 ± 4	16 ± 4
12/05/18 - 12/12/18	32 ± 5	30 ± 5	29 ± 5	28 ± 5	29 ± 5	24 ± 4
12/12/18 - 12/19/18	23 ± 5	31 ± 5	25 ± 5	28 ± 5	31 ± 5	25 ± 5
12/19/18 - 12/26/18	19 ± 4	19 ± 4	19 ± 4	19 ± 4	20 ± 4	18 ± 4
12/26/18 - 01/02/19	16 ± 4	15 ± 4	14 ± 4	15 ± 4	17 ± 4	13 ± 4
MEAN ± 2 STD DEV	18 ± 11	18 ± 11	17 ± 11	18 ± 10	18 ± 12	17 ± 9

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

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VI.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

COLLECTION PERIOD	GROUP II			GROUP III
	CL-1	CL-7	CL-8	CL-11
01/03/18 - 01/10/18	23 ± 5	27 ± 5	31 ± 5	30 ± 5
01/10/18 - 01/17/18	17 ± 4	15 ± 4	15 ± 4	16 ± 4
01/17/18 - 01/24/18	17 ± 4	18 ± 4	16 ± 4	17 ± 4
01/24/18 - 01/31/18	13 ± 4	15 ± 4	16 ± 4	13 ± 4
01/31/18 - 02/07/18	15 ± 4	14 ± 4	17 ± 5	17 ± 5
02/07/18 - 02/14/18	25 ± 5	26 ± 5	26 ± 5	25 ± 5
02/14/18 - 02/21/18	19 ± 4	17 ± 4	18 ± 4	22 ± 5
02/21/18 - 02/28/18	13 ± 4	14 ± 4	14 ± 4	16 ± 4
02/28/18 - 03/07/18	16 ± 4	11 ± 4	10 ± 4	14 ± 4
03/07/18 - 03/14/18	17 ± 4	14 ± 4	19 ± 4	17 ± 4
03/14/18 - 03/21/18	16 ± 4	15 ± 4	14 ± 4	16 ± 4
03/21/18 - 03/28/18	14 ± 4	12 ± 4	12 ± 4	10 ± 4
03/28/18 - 04/04/18	15 ± 4	11 ± 4	16 ± 4	13 ± 4
04/04/18 - 04/11/18	15 ± 4	17 ± 4	18 ± 5	16 ± 4
04/11/18 - 04/18/18	12 ± 4	15 ± 4	15 ± 4	13 ± 4
04/18/18 - 04/25/18	13 ± 4	18 ± 4	15 ± 4	13 ± 4
04/25/18 - 05/02/18	16 ± 4	15 ± 4	16 ± 4	13 ± 4
05/02/18 - 05/09/18	20 ± 4	18 ± 4	23 ± 4	25 ± 5
05/09/18 - 05/16/18	16 ± 5	16 ± 5	15 ± 5	17 ± 5
05/16/18 - 05/23/18	20 ± 4	18 ± 4	20 ± 4	16 ± 4
05/23/18 - 05/30/18	20 ± 4	23 ± 5	19 ± 4	20 ± 4
05/30/18 - 06/06/18	15 ± 4	15 ± 4	16 ± 4	18 ± 4
06/06/18 - 06/13/18	18 ± 4	20 ± 4	20 ± 4	21 ± 4
06/13/18 - 06/20/18	16 ± 4	15 ± 4	19 ± 4	15 ± 4
06/20/18 - 06/27/18	12 ± 4	10 ± 3	13 ± 4	12 ± 3
06/27/18 - 07/04/18	18 ± 4	12 ± 4	14 ± 4	6 ± 3
07/04/18 - 07/11/18	20 ± 4	21 ± 5	18 ± 4	16 ± 4
07/11/18 - 07/18/18	16 ± 4	18 ± 4	17 ± 4	18 ± 4
07/18/18 - 07/25/18 *(1)*				
07/25/18 - 08/01/18	19 ± 4	18 ± 4	18 ± 4	15 ± 4
08/01/18 - 08/08/18	30 ± 5	28 ± 5	27 ± 5	27 ± 5
08/08/18 - 08/15/18	25 ± 4	22 ± 4	24 ± 4	12 ± 3
08/15/18 - 08/22/18	18 ± 4	15 ± 4	18 ± 4	17 ± 4
08/22/18 - 08/29/18	22 ± 4	18 ± 4	18 ± 4	19 ± 4
08/29/18 - 09/05/18	15 ± 4	14 ± 4	17 ± 4	15 ± 4
09/05/18 - 09/12/18	9 ± 3	10 ± 3	12 ± 4	14 ± 4
09/12/18 - 09/19/18	17 ± 4	18 ± 4	20 ± 5	22 ± 5
09/19/18 - 09/26/18	13 ± 4	14 ± 4	16 ± 4	15 ± 4
09/26/18 - 10/03/18	19 ± 4	21 ± 4	21 ± 4	17 ± 4
10/03/18 - 10/10/18	14 ± 4	12 ± 4	14 ± 4	16 ± 4
10/10/18 - 10/17/18	12 ± 4	12 ± 4	14 ± 4	12 ± 4
10/17/18 - 10/24/18	14 ± 4	13 ± 4	12 ± 4	11 ± 4
10/24/18 - 10/31/18	15 ± 4	19 ± 4	19 ± 4	16 ± 4
10/31/18 - 11/07/18	16 ± 4	12 ± 4	14 ± 4	15 ± 4
11/07/18 - 11/14/18	19 ± 4	20 ± 4	22 ± 4	18 ± 4
11/14/18 - 11/21/18	25 ± 5	26 ± 5	26 ± 5	25 ± 5
11/21/18 - 11/28/18	35 ± 5	31 ± 5	35 ± 5	31 ± 5
11/28/18 - 12/05/18	16 ± 4	16 ± 4	21 ± 4	20 ± 4
12/05/18 - 12/12/18	28 ± 5	29 ± 5	29 ± 5	29 ± 5
12/12/18 - 12/19/18	22 ± 5	26 ± 5	31 ± 5	23 ± 5
12/19/18 - 12/26/18	21 ± 4	18 ± 4	15 ± 4	14 ± 4
12/26/18 - 01/02/19	12 ± 4	15 ± 4	13 ± 4	16 ± 4
MEAN ± 2 STD DEV	18 ± 10	17 ± 10	18 ± 11	17 ± 10

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

Table C-VI.2 **MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

GROUP I - ON-SITE LOCATIONS				GROUP II - INTERMEDIATE DISTANCE LOCATIONS				GROUP III - CONTROL LOCATIONS			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
01/03/18 - 01/31/18	11	36	20 ± 15	01/03/18 - 01/31/18	13	31	18 ± 11	01/03/18 - 01/31/18	13	30	19 ± 15
01/31/18 - 02/28/18	12	32	19 ± 12	01/31/18 - 02/28/18	13	26	18 ± 9	01/31/18 - 02/28/18	16	25	20 ± 9
02/28/18 - 04/04/18	9	18	14 ± 4	02/28/18 - 04/04/18	10	19	14 ± 5	02/28/18 - 04/04/18	10	17	14 ± 6
04/04/18 - 05/02/18	10	21	15 ± 5	04/04/18 - 05/02/18	12	18	15 ± 4	04/04/18 - 05/02/18	13	16	13 ± 3
05/02/18 - 05/30/18	13	22	18 ± 5	05/02/18 - 05/30/18	15	23	19 ± 5	05/02/18 - 05/30/18	16	25	20 ± 8
05/30/18 - 07/04/18	10	23	15 ± 6	05/30/18 - 07/04/18	10	20	15 ± 6	05/30/18 - 07/04/18	6	21	14 ± 12
07/04/18 - 08/01/18	12	20	17 ± 5	07/04/18 - 08/01/18	16	21	18 ± 3	07/04/18 - 08/01/18	15	18	16 ± 3
08/01/18 - 08/29/18	14	32	22 ± 10	08/01/18 - 08/29/18	15	30	22 ± 9	08/01/18 - 08/29/18	12	27	19 ± 12
08/29/18 - 10/03/18	10	24	15 ± 7	08/29/18 - 10/03/18	9	21	16 ± 8	08/29/18 - 10/03/18	14	22	17 ± 7
10/03/18 - 10/31/18	9	21	14 ± 6	10/03/18 - 10/31/18	12	19	14 ± 5	10/03/18 - 10/31/18	11	16	14 ± 6
10/31/18 - 11/28/18	14	34	22 ± 13	10/31/18 - 11/28/18	12	35	23 ± 15	10/31/18 - 11/28/18	15	31	22 ± 14
11/28/18 - 01/02/19	13	32	21 ± 12	11/28/18 - 01/02/19	12	31	21 ± 13	11/28/18 - 01/02/19	14	29	21 ± 12
01/03/18 - 01/02/19	9	36	18 ± 11	01/03/18 - 01/02/19	9	35	18 ± 10	01/03/18 - 01/02/19	6	31	17 ± 10

Table C-VI.3 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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

SITE	COLLECTION PERIOD	Co-60	Nb-95	Zr-95	Ru-103	Ru-106	Cs-134	Cs-137	Ce-141	Ce-144
CL-1	01/03/18 - 04/04/18	< 2	< 2	< 3	< 2	< 18	< 2	< 2	< 3	< 10
	04/04/18 - 07/04/18	< 3	< 3	< 5	< 2	< 21	< 3	< 3	< 4	< 11
	07/04/18 - 10/03/18	< 3	< 3	< 5	< 3	< 22	< 3	< 2	< 4	< 11
	10/03/18 - 01/02/19	< 3	< 2	< 3	< 3	< 23	< 2	< 3	< 3	< 10
	MEAN	-	-	-	-	-	-	-	-	-
CL-2	01/03/18 - 04/04/18	< 3	< 3	< 5	< 3	< 20	< 2	< 2	< 3	< 9
	04/04/18 - 07/04/18	< 3	< 3	< 4	< 2	< 21	< 2	< 3	< 4	< 10
	07/04/18 - 10/03/18	< 3	< 2	< 5	< 3	< 23	< 3	< 2	< 4	< 11
	10/03/18 - 01/02/19	< 2	< 2	< 5	< 2	< 23	< 3	< 2	< 3	< 10
	MEAN	-	-	-	-	-	-	-	-	-
CL-3	01/03/18 - 04/04/18	< 3	< 2	< 4	< 3	< 24	< 2	< 2	< 2	< 6
	04/04/18 - 07/04/18	< 2	< 2	< 5	< 2	< 17	< 2	< 2	< 3	< 9
	07/04/18 - 10/03/18	< 2	< 2	< 4	< 3	< 15	< 1	< 3	< 3	< 8
	10/03/18 - 01/02/19	< 3	< 3	< 5	< 3	< 23	< 3	< 3	< 4	< 14
	MEAN	-	-	-	-	-	-	-	-	-
CL-4	01/03/18 - 04/04/18	< 4	< 5	< 8	< 4	< 32	< 4	< 3	< 4	< 14
	04/04/18 - 07/04/18	< 3	< 4	< 7	< 4	< 32	< 4	< 3	< 4	< 14
	07/04/18 - 10/03/18	< 3	< 2	< 5	< 3	< 20	< 2	< 1	< 4	< 10
	10/03/18 - 01/02/19	< 3	< 3	< 5	< 3	< 21	< 4	< 3	< 4	< 15
	MEAN	-	-	-	-	-	-	-	-	-
CL-6	01/03/18 - 04/04/18	< 2	< 2	< 4	< 2	< 17	< 2	< 2	< 3	< 9
	04/04/18 - 07/04/18	< 2	< 2	< 5	< 3	< 23	< 3	< 3	< 4	< 11
	07/04/18 - 10/03/18	< 3	< 3	< 5	< 3	< 22	< 3	< 3	< 4	< 12
	10/03/18 - 01/02/19	< 2	< 2	< 3	< 2	< 22	< 2	< 2	< 3	< 9
	MEAN	-	-	-	-	-	-	-	-	-

Table C-VI.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

SITE	COLLECTION PERIOD	Co-60	Nb-95	Zr-95	Ru-103	Ru-106	Cs-134	Cs-137	Ce-141	Ce-144
CL-7	01/03/18 - 04/04/18	< 1	< 2	< 4	< 3	< 22	< 3	< 2	< 4	< 11
	04/04/18 - 07/04/18	< 2	< 2	< 4	< 2	< 20	< 3	< 2	< 3	< 10
	07/04/18 - 10/03/18	< 4	< 2	< 6	< 3	< 17	< 2	< 2	< 4	< 9
	10/03/18 - 01/02/19	< 2	< 2	< 4	< 2	< 21	< 2	< 2	< 3	< 8
	MEAN	-	-	-	-	-	-	-	-	-
CL-8	01/03/18 - 04/04/18	< 3	< 3	< 4	< 3	< 20	< 3	< 2	< 2	< 7
	04/04/18 - 07/04/18	< 2	< 2	< 3	< 2	< 16	< 2	< 2	< 3	< 9
	07/04/18 - 10/03/18	< 3	< 4	< 8	< 5	< 28	< 4	< 3	< 6	< 14
	10/03/18 - 01/02/19	< 3	< 3	< 4	< 3	< 22	< 3	< 3	< 4	< 14
	MEAN	-	-	-	-	-	-	-	-	-
CL-11	01/03/18 - 04/04/18	< 4	< 4	< 7	< 4	< 26	< 3	< 3	< 4	< 13
	04/04/18 - 07/04/18	< 2	< 3	< 5	< 2	< 19	< 2	< 2	< 3	< 9
	07/04/18 - 10/03/18	< 2	< 3	< 5	< 3	< 18	< 3	< 3	< 4	< 10
	10/03/18 - 01/02/19	< 3	< 2	< 4	< 2	< 17	< 3	< 2	< 3	< 10
	MEAN	-	-	-	-	-	-	-	-	-
CL-15	01/03/18 - 04/04/18	< 2	< 2	< 4	< 2	< 15	< 2	< 2	< 3	< 9
	04/04/18 - 07/04/18	< 2	< 3	< 5	< 3	< 18	< 2	< 3	< 3	< 13
	07/04/18 - 10/03/18	< 3	< 2	< 5	< 3	< 19	< 3	< 2	< 4	< 10
	10/03/18 - 01/02/19	< 3	< 3	< 6	< 3	< 26	< 3	< 3	< 4	< 14
	MEAN	-	-	-	-	-	-	-	-	-
CL-94	01/03/18 - 04/04/18	< 2	< 2	< 3	< 3	< 18	< 2	< 2	< 3	< 8
	04/04/18 - 07/04/18	< 3	< 3	< 4	< 2	< 23	< 3	< 2	< 3	< 10
	07/04/18 - 10/03/18	< 3	< 2	< 4	< 2	< 18	< 2	< 2	< 3	< 8
	10/03/18 - 01/02/19	< 2	< 2	< 4	< 3	< 19	< 2	< 2	< 2	< 8
	MEAN	-	-	-	-	-	-	-	-	-

Table C-VII.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

COLLECTION	GROUP I					
PERIOD	CL-2	CL-3	CL-4	CL-6	CL-15	CL-94
01/03/18 - 01/10/18	< 48	< 48	< 48	< 48	< 27	< 27
01/10/18 - 01/17/18	< 65	< 67	< 68	< 67	< 62	< 62
01/17/18 - 01/24/18	< 48	< 48	< 48	< 47	< 33	< 33
01/24/18 - 01/31/18	< 47	< 47	< 47	< 46	< 33	< 34
01/31/18 - 02/07/18	< 35	< 35	< 35	< 35	< 24	< 20
02/07/18 - 02/14/18	< 48	< 47	< 48	< 48	< 51	< 51
02/14/18 - 02/21/18	< 36	< 36	< 36	< 35	< 23	< 23
02/21/18 - 02/28/18	< 57	< 58	< 57	< 58	< 29	< 29
02/28/18 - 03/07/18	< 61	< 60	< 60	< 60	< 29	< 29
03/07/18 - 03/14/18	< 41	< 42	< 40	< 40	< 26	< 26
03/14/18 - 03/21/18	< 56	< 57	< 56	< 56	< 31	< 31
03/21/18 - 03/28/18	< 41	< 41	< 41	< 41	< 28	< 15
03/28/18 - 04/04/18	< 29	< 29	< 29	< 29	< 26	< 26
04/04/18 - 04/11/18	< 54	< 57	< 55	< 55	< 27	< 27
04/11/18 - 04/18/18	< 47	< 46	< 19	< 47	< 29	< 29
04/18/18 - 04/25/18	< 24	< 24	< 24	< 54	< 54	< 23
04/25/18 - 05/02/18	< 17	< 18	< 17	< 17	< 31	< 31
05/02/18 - 05/09/18	< 56	< 56	< 55	< 56	< 18	< 34
05/09/18 - 05/16/18	< 31	< 32	< 32	< 51	< 24	< 24
05/16/18 - 05/23/18	< 41	< 41	< 41	< 21	< 24	< 24
05/23/18 - 05/30/18	< 61	< 61	< 61	< 30	< 50	< 50
05/30/18 - 06/06/18	< 30	< 31	< 30	< 30	< 53	< 54
06/06/18 - 06/13/18	< 52	< 50	< 52	< 52	< 31	< 31
06/13/18 - 06/20/18	< 26	< 26	< 26	< 26	< 33	< 33
06/20/18 - 06/27/18	< 41	< 41	< 41	< 41	< 57	< 24
06/27/18 - 07/04/18	< 61	< 61	< 61	< 61	< 41	< 41
07/04/18 - 07/11/18	< 32	< 32	< 32	< 32	< 51	< 21
07/11/18 - 07/18/18	< 32	< 32	< 32	< 32	< 63	< 63
07/18/18 - 07/25/18 *(1)*						
07/25/18 - 08/01/18	< 55	< 55	< 55	< 55	< 46	< 46
08/01/18 - 08/08/18	< 66	< 66	< 66	< 66	< 50	< 50
08/08/18 - 08/15/18	< 57	< 55	< 57	< 57	< 60	< 60
08/15/18 - 08/22/18	< 65	< 65	< 66	< 65	< 57	< 57
08/22/18 - 08/29/18	< 32	< 33	< 31	< 32	< 39	< 37
08/29/18 - 09/05/18	< 46	< 46	< 46	< 46	< 55	< 56
09/05/18 - 09/12/18	< 31	< 31	< 30	< 30	< 58	< 57
09/12/18 - 09/19/18	< 35	< 35	< 35	< 35	< 24	< 57
09/19/18 - 09/26/18	< 65	< 64	< 67	< 67	< 31	< 32
09/26/18 - 10/03/18	< 48	< 48	< 49	< 49	< 63	< 64
10/03/18 - 10/10/18	< 47	< 47	< 47	< 47	< 51	< 27
10/10/18 - 10/17/18	< 46	< 46	< 36	< 44	< 60	< 59
10/17/18 - 10/24/18	< 32	< 31	< 31	< 31	< 47	< 47
10/24/18 - 10/31/18	< 39	< 39	< 39	< 39	< 54	< 54
10/31/18 - 11/07/18	< 35	< 36	< 36	< 36	< 56	< 56
11/07/18 - 11/14/18	< 29	< 29	< 29	< 29	< 65	< 65
11/14/18 - 11/21/18	< 49	< 49	< 49	< 49	< 34	< 35
11/21/18 - 11/28/18	< 59	< 60	< 61	< 25	< 58	< 57
11/28/18 - 12/05/18	< 20	< 19	< 19	< 19	< 38	< 38
12/05/18 - 12/12/18	< 33	< 32	< 32	< 33	< 56	< 57
12/12/18 - 12/19/18	< 41	< 42	< 41	< 41	< 48	< 47
12/19/18 - 12/26/18	< 69	< 68	< 69	< 69	< 67	< 68
12/26/18 - 01/02/19	< 59	< 61	< 60	< 60	< 68	< 69
MEAN	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018**

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

COLLECTION	GROUP II			GROUP III
PERIOD	CL-1	CL-7	CL-8	CL-11
01/03/18 - 01/10/18	< 20	< 27	< 27	< 22
01/10/18 - 01/17/18	< 35	< 33	< 62	< 62
01/17/18 - 01/24/18	< 20	< 27	< 33	< 32
01/24/18 - 01/31/18	< 20	< 34	< 34	< 27
01/31/18 - 02/07/18	< 15	< 24	< 24	< 24
02/07/18 - 02/14/18	< 24	< 28	< 50	< 49
02/14/18 - 02/21/18	< 15	< 23	< 23	< 19
02/21/18 - 02/28/18	< 24	< 29	< 24	< 29
02/28/18 - 03/07/18	< 26	< 24	< 29	< 28
03/07/18 - 03/14/18	< 17	< 21	< 26	< 26
03/14/18 - 03/21/18	< 24	< 26	< 31	< 31
03/21/18 - 03/28/18	< 17	< 28	< 27	< 28
03/28/18 - 04/04/18	< 12	< 15	< 26	< 26
04/04/18 - 04/11/18	< 23	< 22	< 27	< 26
04/11/18 - 04/18/18	< 48	< 24	< 29	< 29
04/18/18 - 04/25/18	< 24	< 53	< 53	< 20
04/25/18 - 05/02/18	< 14	< 13	< 31	< 31
05/02/18 - 05/09/18	< 24	< 34	< 34	< 34
05/09/18 - 05/16/18	< 32	< 52	< 52	< 23
05/16/18 - 05/23/18	< 41	< 21	< 21	< 24
05/23/18 - 05/30/18	< 61	< 30	< 30	< 49
05/30/18 - 06/06/18	< 17	< 19	< 54	< 54
06/06/18 - 06/13/18	< 27	< 17	< 31	< 31
06/13/18 - 06/20/18	< 22	< 28	< 33	< 34
06/20/18 - 06/27/18	< 34	< 56	< 57	< 55
06/27/18 - 07/04/18	< 25	< 35	< 41	< 41
07/04/18 - 07/11/18	< 26	< 50	< 50	< 50
07/11/18 - 07/18/18	< 27	< 27	< 63	< 63
07/18/18 - 07/25/18 *(1)*				
07/25/18 - 08/01/18	< 29	< 19	< 46	< 47
08/01/18 - 08/08/18	< 28	< 21	< 50	< 49
08/08/18 - 08/15/18	< 25	< 31	< 60	< 58
08/15/18 - 08/22/18	< 34	< 20	< 57	< 56
08/22/18 - 08/29/18	< 27	< 31	< 37	< 37
08/29/18 - 09/05/18	< 19	< 24	< 56	< 55
09/05/18 - 09/12/18	< 27	< 24	< 57	< 59
09/12/18 - 09/19/18	< 30	< 57	< 57	< 58
09/19/18 - 09/26/18	< 28	< 26	< 32	< 31
09/26/18 - 10/03/18	< 26	< 63	< 28	< 63
10/03/18 - 10/10/18	< 26	< 51	< 51	< 51
10/10/18 - 10/17/18	< 46	< 25	< 59	< 59
10/17/18 - 10/24/18	< 26	< 19	< 46	< 46
10/24/18 - 10/31/18	< 33	< 23	< 54	< 55
10/31/18 - 11/07/18	< 30	< 56	< 55	< 23
11/07/18 - 11/14/18	< 24	< 27	< 65	< 65
11/14/18 - 11/21/18	< 23	< 29	< 34	< 34
11/21/18 - 11/28/18	< 61	< 24	< 58	< 57
11/28/18 - 12/05/18	< 16	< 32	< 37	< 38
12/05/18 - 12/12/18	< 28	< 24	< 57	< 57
12/12/18 - 12/19/18	< 36	< 26	< 47	< 47
12/19/18 - 12/26/18	< 30	< 37	< 68	< 67
12/26/18 - 01/02/19	< 25	< 29	< 69	< 69
MEAN	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VIII.1 CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	CONTROL FARM CL-116
01/31/18	< 0.5
02/28/18	< 0.7
03/28/18	< 0.6
04/25/18	< 0.7
05/09/18	< 0.6
05/23/18	< 0.5
06/06/18	< 0.6
06/20/18	< 0.7
07/04/18	< 0.7
07/18/18	< 0.8
08/01/18	< 0.6
08/15/18	< 0.8
08/29/18	< 0.6
09/12/18	< 0.7
09/26/18	< 0.5
10/10/18	< 0.6
10/24/18	< 0.7
11/28/18	< 0.7
12/26/18	< 0.7
MEAN	-

Table C-VIII.2

CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140	Ce-144
CL-116	01/31/18	1024 ± 151	< 10	< 10	< 20	< 11	< 27	< 11	< 18	< 11	< 9	< 39	< 11	< 92
	02/28/18	1133 ± 165	< 11	< 11	< 24	< 11	< 33	< 13	< 17	< 12	< 12	< 53	< 14	< 99
	03/28/18	1184 ± 140	< 7	< 7	< 13	< 9	< 15	< 7	< 13	< 8	< 7	< 31	< 9	< 59
	04/25/18	790 ± 133	< 8	< 8	< 17	< 8	< 18	< 7	< 14	< 8	< 9	< 34	< 13	< 56
	05/09/18	952 ± 137	< 5	< 6	< 14	< 6	< 14	< 6	< 11	< 7	< 7	< 29	< 10	< 45
	05/23/18	1103 ± 138	< 6	< 7	< 13	< 6	< 14	< 7	< 11	< 6	< 7	< 32	< 7	< 52
	06/06/18	1090 ± 165	< 7	< 9	< 21	< 10	< 20	< 7	< 14	< 9	< 9	< 35	< 10	< 58
	06/20/18	1184 ± 174	< 6	< 7	< 15	< 5	< 17	< 8	< 11	< 8	< 8	< 26	< 8	< 57
	07/04/18	1118 ± 188	< 7	< 7	< 16	< 8	< 22	< 8	< 14	< 9	< 8	< 35	< 12	< 55
	07/18/18	1244 ± 201	< 9	< 7	< 23	< 10	< 16	< 8	< 13	< 10	< 10	< 41	< 14	< 66
	08/01/18	1273 ± 148	< 8	< 7	< 18	< 10	< 21	< 8	< 12	< 8	< 8	< 32	< 11	< 48
	08/15/18	1333 ± 166	< 5	< 5	< 16	< 11	< 13	< 7	< 11	< 8	< 7	< 25	< 10	< 44
	08/29/18	1200 ± 170	< 7	< 6	< 14	< 7	< 16	< 7	< 11	< 8	< 7	< 28	< 8	< 51
	09/12/18	1207 ± 154	< 6	< 7	< 16	< 7	< 20	< 7	< 10	< 7	< 8	< 36	< 10	< 54
	09/26/18	1262 ± 185	< 8	< 8	< 17	< 8	< 19	< 9	< 16	< 9	< 7	< 33	< 11	< 51
	10/10/18	1154 ± 149	< 6	< 6	< 12	< 7	< 17	< 8	< 14	< 7	< 7	< 36	< 10	< 49
	10/24/18	1118 ± 112	< 5	< 6	< 13	< 7	< 14	< 6	< 9	< 6	< 6	< 24	< 7	< 39
	11/28/18	1063 ± 196	< 6	< 8	< 13	< 8	< 16	< 8	< 11	< 8	< 7	< 27	< 12	< 45
	12/26/18	1026 ± 144	< 7	< 7	< 17	< 7	< 14	< 7	< 11	< 8	< 6	< 39	< 11	< 45
	MEAN	1129 ± 252	-	-	-	-	-	-	-	-	-	-	-	-

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

Table C-IX.1

CONCENTRATIONS OF GAMMA EMITTERS IN VEGETATION SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-114														
Cabbage	06/27/18	< 23	< 21	< 67	< 25	< 57	< 28	< 43	< 49	< 29	< 27	< 96	< 36	< 126
Kale/Swiss Chard	06/27/18	< 9	< 10	< 23	< 10	< 23	< 10	< 18	< 21	< 11	< 11	< 54	< 13	< 66
Lettuce	06/27/18	< 34	< 25	< 59	< 45	< 76	< 29	< 47	< 58	< 30	< 32	< 142	< 34	< 169
Cabbage	07/25/18	< 27	< 25	< 65	< 27	< 71	< 37	< 51	< 45	< 37	< 29	< 142	< 37	< 207
Cabbage/Lettuce	07/25/18	< 30	< 39	< 70	< 31	< 71	< 38	< 58	< 58	< 35	< 31	< 174	< 44	< 249
Cabbage/Swiss Chard	07/25/18	< 32	< 31	< 64	< 34	< 56	< 30	< 51	< 45	< 34	< 36	< 128	< 36	< 191
Cabbage	08/29/18	< 31	< 34	< 55	< 35	< 69	< 38	< 56	< 58	< 33	< 28	< 155	< 49	< 199
Cabbage/Weeds	09/26/18	< 19	< 21	< 52	< 22	< 45	< 20	< 36	< 50	< 26	< 22	< 119	< 36	< 127
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-115														
Corn	06/27/18	< 31	< 34	< 60	< 32	< 62	< 33	< 46	< 55	< 31	< 29	< 163	< 50	< 210
Corn Leaves	07/25/18	< 24	< 29	< 57	< 29	< 50	< 25	< 46	< 50	< 25	< 28	< 129	< 38	< 193
Corn Leaves	08/29/18	< 26	< 23	< 46	< 26	< 70	< 28	< 43	< 50	< 29	< 21	< 118	< 37	< 164
Corn	09/26/18	< 16	< 16	< 36	< 15	< 35	< 15	< 28	< 38	< 15	< 16	< 93	< 20	< 94
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-117														
Cabbage	06/27/18	< 25	< 27	< 66	< 31	< 84	< 26	< 51	< 45	< 23	< 29	< 143	< 46	< 167
Lettuce	06/27/18	< 34	< 31	< 59	< 33	< 53	< 29	< 53	< 44	< 26	< 24	< 139	< 43	< 170
Swiss Chard	06/27/18	< 35	< 32	< 73	< 27	< 68	< 34	< 46	< 58	< 29	< 38	< 161	< 33	< 179
Cabbage	07/25/18	< 35	< 26	< 58	< 26	< 66	< 32	< 44	< 45	< 32	< 25	< 154	< 28	< 164
Kale	07/25/18	< 27	< 22	< 68	< 25	< 63	< 24	< 55	< 47	< 31	< 31	< 120	< 36	< 157
Swiss Chard	07/25/18	< 33	< 27	< 93	< 43	< 75	< 36	< 56	< 52	< 40	< 35	< 165	< 53	< 193
Cabbage	08/29/18	< 33	< 25	< 63	< 37	< 79	< 22	< 59	< 54	< 29	< 30	< 146	< 43	< 186
Kale	08/29/18	< 27	< 23	< 60	< 28	< 67	< 27	< 53	< 52	< 37	< 33	< 141	< 46	< 192
Swiss Chard	08/29/18	< 20	< 18	< 55	< 21	< 57	< 22	< 37	< 36	< 23	< 23	< 91	< 28	< 129
Cabbage	09/26/18	< 22	< 23	< 63	< 26	< 53	< 30	< 45	< 56	< 27	< 28	< 136	< 35	< 155
Kale	09/26/18	< 15	< 16	< 40	< 16	< 39	< 16	< 33	< 42	< 19	< 17	< 92	< 27	< 104
Swiss Chard	09/26/18	< 19	< 24	< 48	< 23	< 47	< 20	< 40	< 60	< 25	< 23	< 136	< 37	< 135
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-118														
Weeds	06/27/18	< 29	< 32	< 82	< 24	< 74	< 34	< 57	< 59	< 37	< 25	< 148	< 36	< 172
Weeds	07/25/18	< 34	< 27	< 66	< 31	< 76	< 32	< 58	< 47	< 39	< 34	< 166	< 43	< 188
Weeds	08/29/18	< 30	< 30	< 68	< 35	< 64	< 37	< 49	< 46	< 35	< 23	< 161	< 54	< 173
Weeds	09/26/18	< 23	< 24	< 49	< 23	< 50	< 24	< 39	< 58	< 25	< 23	< 126	< 35	< 145
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-IX.2

CONCENTRATIONS OF GAMMA EMITTERS IN GRASS SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-01	05/09/18	< 30	< 33	< 73	< 29	< 81	< 29	< 52	< 49	< 29	< 28	< 149	< 35	< 185
	05/23/18	< 25	< 25	< 48	< 25	< 58	< 25	< 45	< 59	< 28	< 25	< 137	< 41	< 128
	06/06/18	< 33	< 35	< 74	< 37	< 76	< 35	< 55	< 54	< 43	< 42	< 169	< 52	< 207
	06/20/18	< 37	< 31	< 76	< 35	< 51	< 38	< 64	< 47	< 46	< 25	< 129	< 50	< 193
	07/04/18	< 24	< 25	< 65	< 27	< 56	< 23	< 39	< 32	< 26	< 29	< 101	< 35	< 138
	07/18/18	< 39	< 29	< 70	< 29	< 66	< 31	< 56	< 52	< 32	< 29	< 136	< 37	< 197
	08/01/18	< 30	< 24	< 58	< 23	< 61	< 27	< 40	< 43	< 24	< 24	< 123	< 30	< 155
	08/15/18	< 28	< 23	< 54	< 24	< 47	< 27	< 40	< 43	< 25	< 24	< 116	< 31	< 168
	08/29/18	< 23	< 24	< 50	< 23	< 54	< 30	< 38	< 50	< 27	< 25	< 127	< 36	< 163
	09/12/18	< 30	< 27	< 71	< 27	< 71	< 29	< 51	< 57	< 35	< 27	< 136	< 36	< 181
	09/26/18	< 20	< 23	< 44	< 26	< 51	< 22	< 42	< 59	< 22	< 19	< 124	< 39	< 121
	10/10/18	< 20	< 19	< 45	< 21	< 45	< 21	< 42	< 57	< 23	< 21	< 129	< 42	< 136
	10/24/18	< 28	< 29	< 57	< 25	< 50	< 24	< 51	< 48	< 26	< 27	< 104	< 28	< 169
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-02	05/09/18	< 30	< 32	< 72	< 35	< 65	< 24	< 53	< 49	< 30	< 30	< 131	< 40	< 154
	05/23/18	< 27	< 24	< 56	< 23	< 47	< 23	< 46	< 54	< 28	< 26	< 150	< 37	< 137
	06/06/18	< 35	< 32	< 85	< 38	< 78	< 40	< 69	< 59	< 43	< 42	< 178	< 40	< 230
	06/20/18	< 31	< 27	< 72	< 29	< 65	< 25	< 58	< 35	< 33	< 25	< 113	< 39	< 160
	07/04/18	< 29	< 25	< 63	< 30	< 65	< 27	< 42	< 36	< 30	< 25	< 115	< 40	< 190
	07/18/18	< 31	< 29	< 66	< 33	< 56	< 33	< 56	< 55	< 31	< 33	< 139	< 39	< 219
	08/01/18	< 32	< 28	< 63	< 35	< 70	< 32	< 53	< 50	< 33	< 28	< 128	< 33	< 158
	08/15/18	< 34	< 39	< 78	< 37	< 83	< 37	< 67	< 60	< 38	< 31	< 142	< 45	< 233
	08/29/18	< 28	< 25	< 61	< 31	< 70	< 23	< 46	< 57	< 28	< 27	< 148	< 52	< 171
	09/12/18	< 30	< 30	< 63	< 31	< 64	< 34	< 55	< 58	< 34	< 34	< 159	< 44	< 196
	09/26/18	< 19	< 18	< 44	< 21	< 40	< 22	< 32	< 52	< 20	< 21	< 121	< 37	< 126
	10/10/18	< 22	< 22	< 44	< 23	< 54	< 20	< 43	< 58	< 24	< 21	< 138	< 44	< 139
	10/24/18	< 29	< 25	< 70	< 24	< 62	< 26	< 50	< 55	< 31	< 32	< 120	< 28	< 190
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-IX.2

CONCENTRATIONS OF GAMMA EMITTERS IN GRASS SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

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	Ce-144
CL-08	05/09/18	< 30	< 26	< 67	< 31	< 79	< 31	< 55	< 43	< 30	< 27	< 112	< 35	< 175
	05/23/18	< 17	< 18	< 47	< 16	< 43	< 19	< 34	< 51	< 21	< 20	< 95	< 21	< 118
	06/06/18	< 38	< 38	< 87	< 43	< 98	< 36	< 75	< 48	< 45	< 44	< 167	< 58	< 163
	06/20/18	< 14	< 14	< 29	< 15	< 30	< 15	< 25	< 22	< 16	< 15	< 65	< 19	< 84
	07/04/18	< 36	< 24	< 78	< 24	< 53	< 27	< 50	< 42	< 24	< 33	< 127	< 42	< 178
	07/18/18	< 28	< 31	< 77	< 34	< 88	< 38	< 52	< 50	< 36	< 35	< 120	< 40	< 173
	08/01/18	< 34	< 34	< 67	< 35	< 78	< 30	< 50	< 54	< 32	< 31	< 150	< 29	< 183
	08/15/18	< 31	< 31	< 75	< 33	< 87	< 27	< 56	< 56	< 31	< 39	< 158	< 38	< 207
	08/29/18	< 26	< 25	< 62	< 28	< 58	< 31	< 50	< 57	< 32	< 28	< 154	< 44	< 165
	09/12/18	< 27	< 20	< 52	< 27	< 54	< 23	< 45	< 43	< 25	< 25	< 108	< 35	< 141
	09/26/18	< 19	< 20	< 40	< 21	< 47	< 24	< 38	< 58	< 20	< 21	< 126	< 34	< 125
	10/10/18	< 10	< 11	< 27	< 11	< 24	< 12	< 19	< 33	< 12	< 11	< 73	< 20	< 62
	10/24/18	< 32	< 28	< 76	< 31	< 83	< 28	< 55	< 54	< 38	< 35	< 134	< 26	< 205
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-116	05/09/18	< 29	< 38	< 75	< 29	< 72	< 36	< 54	< 52	< 37	< 33	< 166	< 29	< 235
	05/23/18	< 24	< 26	< 48	< 28	< 50	< 25	< 41	< 59	< 25	< 22	< 149	< 42	< 135
	06/06/18	< 39	< 39	< 88	< 42	< 97	< 37	< 68	< 55	< 48	< 39	< 173	< 42	< 267
	06/20/18	< 31	< 31	< 66	< 45	< 78	< 34	< 55	< 57	< 37	< 33	< 146	< 28	< 237
	07/04/18	< 26	< 27	< 62	< 32	< 70	< 30	< 45	< 36	< 34	< 31	< 112	< 33	< 165
	07/18/18	< 28	< 33	< 61	< 30	< 67	< 26	< 42	< 54	< 32	< 29	< 140	< 29	< 208
	08/01/18	< 30	< 28	< 72	< 32	< 72	< 26	< 47	< 51	< 36	< 26	< 129	< 38	< 182
	08/15/18	< 31	< 36	< 79	< 36	< 82	< 33	< 60	< 57	< 34	< 31	< 128	< 26	< 189
	08/29/18	< 25	< 29	< 67	< 24	< 74	< 32	< 55	< 59	< 37	< 32	< 160	< 48	< 193
	09/12/18	< 25	< 30	< 69	< 31	< 63	< 31	< 53	< 51	< 32	< 28	< 145	< 44	< 187
	09/26/18	< 20	< 20	< 45	< 21	< 48	< 18	< 34	< 52	< 21	< 19	< 118	< 31	< 111
	10/10/18	< 21	< 21	< 49	< 24	< 47	< 24	< 39	< 59	< 24	< 24	< 128	< 29	< 124
	10/24/18	< 31	< 30	< 74	< 31	< 71	< 32	< 49	< 54	< 35	< 27	< 155	< 23	< 211
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-X.1 QUARTERLY DLR RESULTS FOR CLINTON POWER STATION, 2018

RESULTS IN UNITS OF MILLIREM/QUARTER ± 2 STANDARD DEVIATIONS

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
CL-01	18.1 ± 1.6	17.8	17.4	18.0	19.3
CL-02	18.7 ± 0.4	18.5	18.6	19.0	18.6
CL-03	18.5 ± 0.6	18.1	18.8	18.5	18.7
CL-04	18.4 ± 1.1	17.8	18.1	18.8	19.0
CL-05	19.0 ± 2.0	19.3	18.6	20.2	17.8
CL-06	16.6 ± 1.0	16.2	16.2	17.2	16.7
CL-07	17.0 ± 1.3	17.0	16.1	17.4	17.6
CL-08	18.2 ± 1.5	18.4	17.9	19.2	17.4
CL-11	17.2 ± 0.9	17.4	16.6	17.0	17.6
CL-15	16.5 ± 0.7	16.5	16.9	16.6	16.0
CL-22	19.7 ± 0.7	19.3	19.6	20.1	19.7
CL-23	20.2 ± 1.8	19.9	21.4	20.2	19.3
CL-24	19.9 ± 0.6	19.5	19.7	20.1	20.1
CL-33	19.4 ± 1.0	19.7	19.9	19.0	18.9
CL-34	18.1 ± 1.6	17.0	18.2	18.7	18.6
CL-35	18.2 ± 2.3	*(1)*	17.0	19.3	18.2
CL-36	18.7 ± 2.2	17.8	18.1	20.3	18.6
CL-37	18.0 ± 0.7	17.9	17.5	18.4	18.0
CL-41	20.2 ± 1.5	19.4	19.9	21.2	20.4
CL-42	18.5 ± 1.7	18.1	19.1	19.3	17.5
CL-43	21.2 ± 5.0	20.3	19.8	24.9	19.7
CL-44	18.4 ± 1.2	17.7	18.1	18.6	19.1
CL-45	20.3 ± 2.3	18.8	20.3	21.5	20.7
CL-46	18.6 ± 1.1	18.5	18.4	18.1	19.4
CL-47	19.8 ± 1.6	19.3	19.0	20.8	20.0
CL-48	19.3 ± 0.9	18.7	19.2	19.8	19.3
CL-49	19.4 ± 1.7	19.4	18.8	20.5	18.7
CL-51	19.9 ± 2.3	20.4	18.5	21.1	19.4
CL-52	19.6 ± 1.3	18.9	20.0	20.3	19.3
CL-53	17.5 ± 1.4	17.1	17.2	18.6	17.2
CL-54	20.2 ± 1.1	20.0	19.7	21.0	20.0
CL-55	19.5 ± 2.9	17.9	19.0	19.7	21.4
CL-56	20.2 ± 0.7	19.7	20.5	20.2	20.3
CL-57	20.2 ± 1.0	20.1	20.3	20.8	19.6
CL-58	20.1 ± 1.4	19.0	20.2	20.4	20.6
CL-60	19.8 ± 0.6	19.4	19.6	19.9	20.1
CL-61	18.6 ± 2.2	17.4	18.2	20.0	18.9
CL-63	16.9 ± 0.2	16.8	16.9	16.9	17.0
CL-64	18.4 ± 1.7	18.3	19.3	17.3	18.7
CL-65	19.8 ± 1.1	20.1	19.0	19.9	20.2
CL-74	16.9 ± 0.9	16.9	16.2	17.1	17.2
CL-75	18.7 ± 0.9	18.5	18.2	19.3	18.6
CL-76	18.7 ± 2.5	18.5	17.0	19.9	19.2
CL-77	17.9 ± 1.5	17.7	17.0	18.8	18.2
CL-78	18.0 ± 0.6	17.7	17.7	18.2	18.2
CL-79	18.7 ± 1.6	17.8	18.5	19.7	18.8
CL-80	18.9 ± 2.1	17.9	18.7	18.5	20.4
CL-81	19.7 ± 2.1	18.4	20.0	20.9	19.3
CL-84	18.9 ± 0.9	18.5	18.7	19.5	18.8
CL-90	14.9 ± 0.8	14.9	14.6	15.5	14.7
CL-91	17.6 ± 1.6	16.7	17.7	18.6	17.3
CL-97	19.5 ± 2.1	18.0	20.2	19.7	20.2
CL-99	15.2 ± 0.4	15.3	15.1	15.4	14.9
CL-114	18.6 ± 2.6	18.3	18.5	20.3	17.1

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

TABLE C-X.2 MEAN QUARTLY DLR RESULTS FOR THE INNER RING, OUTER RING, SPECIAL INTEREST SUPPLEMENTAL AND CONTROL LOCATIONS FOR CLINTON POWER STATION, 2018

RESULTS IN UNITS OF MILLIREM/QUARTER ± 2 STANDARD DEVIATIONS OF THE STATION DATA

COLLECTION PERIOD	INNER RING ± 2 S.D.	OUTER RING	SPECIAL INTEREST	SUPPLEMENTAL	CONTROL
JAN-MAR	18.6 ± 2.1	18.6 ± 2.1	18.6 ± 2.2	17.4 ± 2.7	17.4 ± 0
APR-JUN	18.8 ± 2.4	18.9 ± 2.4	18.4 ± 2.5	17.7 ± 3.4	16.6 ± 0
JUL-SEP	19.8 ± 3.6	19.9 ± 1.8	19.1 ± 3.1	18.2 ± 3.1	17.0 ± 0
OCT-DEC	19.0 ± 2.0	19.4 ± 2.1	18.8 ± 2.3	17.6 ± 3.2	17.6 ± 0

TABLE C-X.3 SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR CLINTON POWER STATION, 2018

RESULTS IN UNITS OF MILLIREM/QUARTER ± 2 STANDARD DEVIATION

LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.	PRE-OP MEAN ± 2 S.D, ALL LOCATIONS
INNER RING	63	16.8	24.9	19.1 ± 2.7	
OUTER RING	64	17.0	21.4	19.2 ± 2.3	18.0 ± 2.4
SPECIAL INTEREST	28	16.2	21.2	18.7 ± 2.5	
SUPPLEMENTAL	56	14.6	20.3	17.7 ± 3.1	
CONTROL	4	16.6	17.6	17.2 ± 0.9	

INNER RING STATIONS - CL-01, CL-05, CL-22, CL-23, CL-24, CL-34, CL-35, CL-36, CL-42, CL-43, CL-44, CL-45, CL-46, CL-47, CL-48, CL-63

OUTER RING STATIONS - CL-51, CL-52, CL-53, CL-54, CL-55, CL-56, CL-57, CL-58, CL-60, CL-61, CL-76, CL-77, CL-78, CL-79, CL-80, CL-81

SPECIAL INTEREST STATIONS - CL-37, CL-41, CL-49, CL-64, CL-65, CL-74, CL-75

SUPPLEMENTAL STATIONS - CL-02, CL-03, CL-04, CL-06, CL-07, CL-08, CL-114, CL-15, CL-33, CL-84, CL-90, CL-91, CL-97, CL-99

CONTROL STATIONS - CL-11

FIGURE C-1
MEAN MONTHLY GROSS BETA CONCENTRATION IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF CPS, 2018

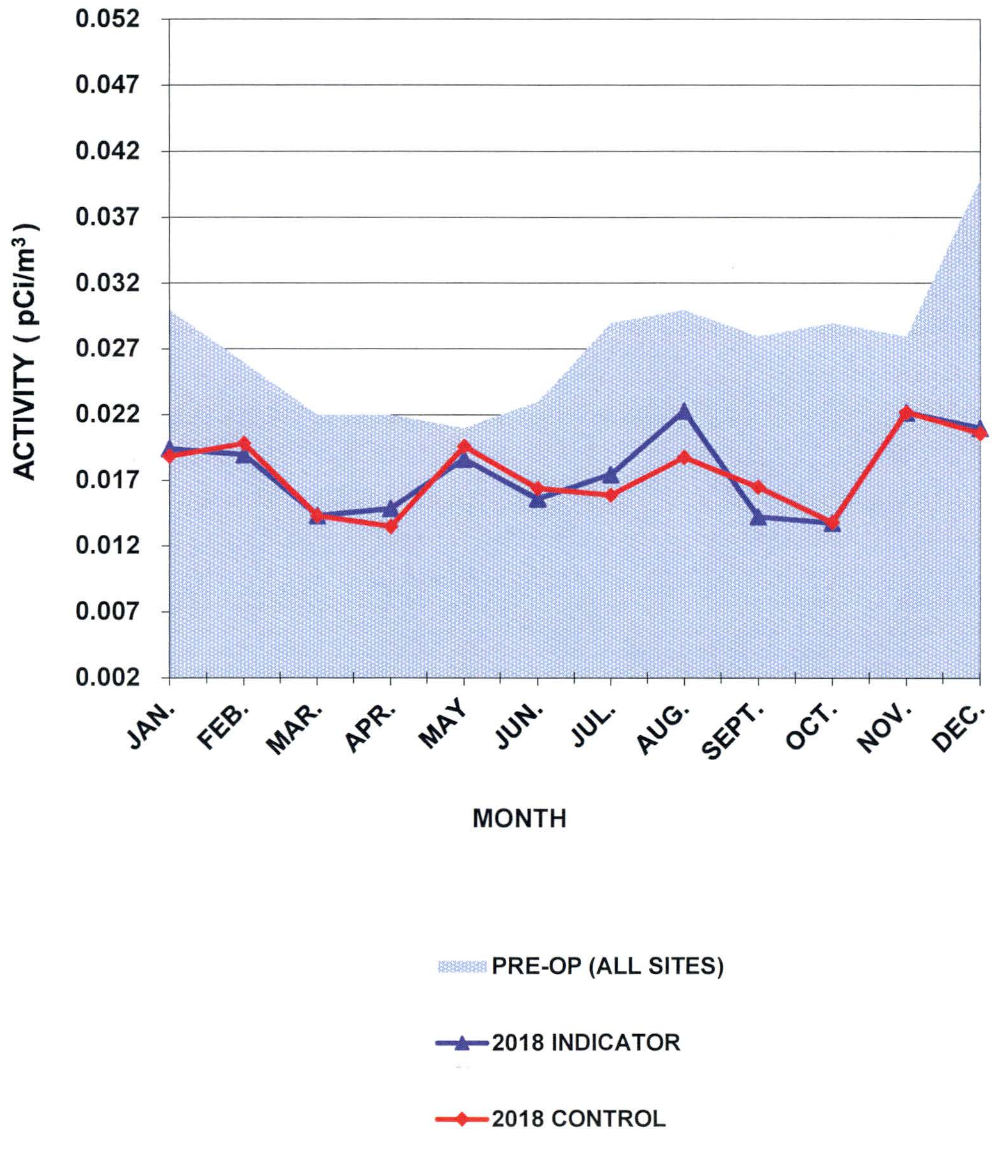
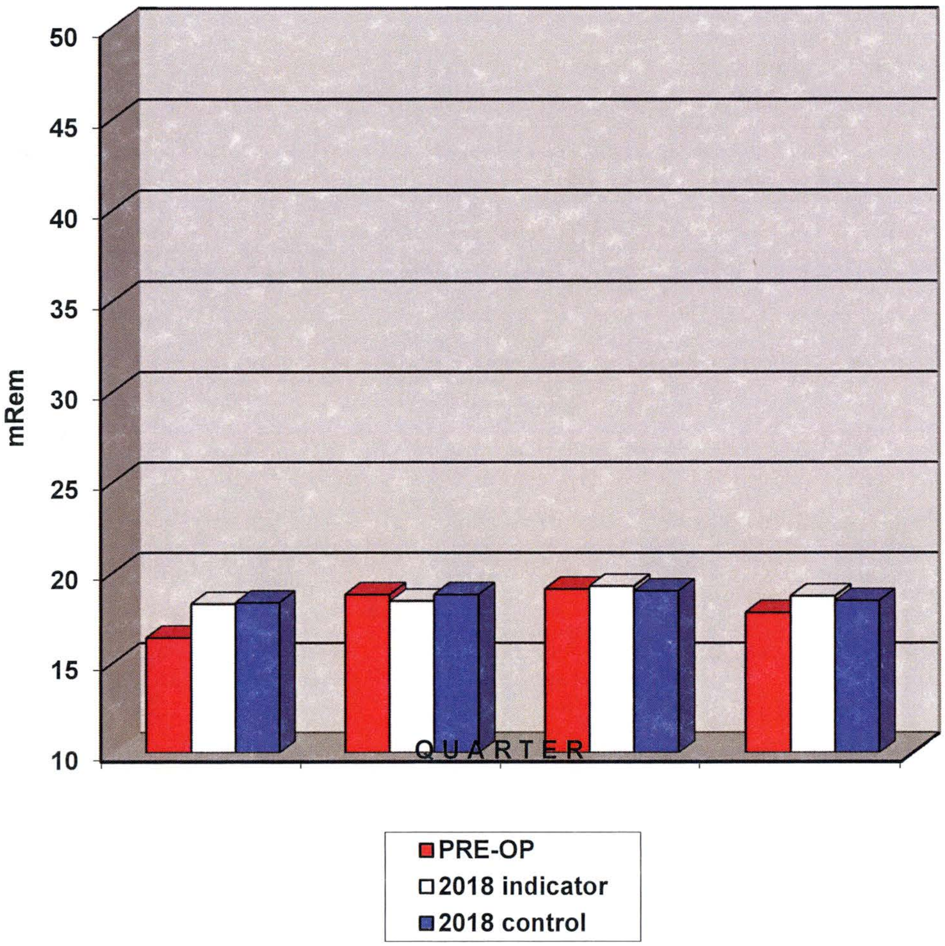


FIGURE C-2
MEAN QUARTERLY AMBIENT GAMMA RADIATION LEVELS (DLR) IN THE VICINITY OF CPS, 2018



Intentionally left blank

APPENDIX D

INTER-LABORATORY COMPARISON PROGRAM

Intentionally Left Blank

TABLE D.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 2018	E12133	Milk	Sr-89	pCi/L	76.1	90.1	0.84	A
			Sr-90	pCi/L	12.2	12.5	0.98	A
	E12134	Milk	Ce-141	pCi/L	77.8	77.0	1.01	A
			Co-58	pCi/L	105	114	0.92	A
			Co-60	pCi/L	181	187	0.97	A
			Cr-51	pCi/L	298	326	0.92	A
			Cs-134	pCi/L	150	180	0.84	A
			Cs-137	pCi/L	164	172	0.95	A
			Fe-59	pCi/L	140	139	1.01	A
			I-131	pCi/L	105	108.0	0.97	A
			Mn-54	pCi/L	133	131	1.01	A
			Zn-65	pCi/L	242	244	0.99	A
	E12135	Charcoal	I-131	pCi	93.7	95.4	0.98	A
	E12136	AP	Ce-141	pCi	92.6	85.3	1.09	A
			Co-58	pCi	130	126	1.03	A
			Co-60	pCi	237	207	1.14	A
			Cr-51	pCi	411	361	1.14	A
			Cs-134	pCi	194	199	0.98	A
			Cs-137	pCi	200	191	1.05	A
			Fe-59	pCi	160	154	1.04	A
			Mn-54	pCi	152	145	1.05	A
			Zn-65	pCi	267	271	0.99	A
	E12137	Water	Fe-55	pCi/L	1990	1700	1.17	A
	E12138	Soil	Ce-141	pCi/g	0.148	0.118	1.26	W
			Co-58	pCi/g	0.171	0.174	0.98	A
			Co-60	pCi/g	0.297	0.286	1.04	A
			Cr-51	pCi/g	0.537	0.498	1.08	A
			Cs-134	pCi/g	0.274	0.275	1.00	A
			Cs-137	pCi/g	0.355	0.337	1.05	A
			Fe-59	pCi/g	0.243	0.212	1.15	A
			Mn-54	pCi/g	0.228	0.201	1.14	A
			Zn-65	pCi/g	0.395	0.374	1.06	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.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)]
June 2018	E12205	Milk	Sr-89	pCi/L	74.9	84.6	0.89	A
			Sr-90	pCi/L	10.5	11.4	0.92	A
	E12206	Milk	Ce-141	pCi/L	89.2	82.2	1.08	A
			Co-58	pCi/L	94.8	89	1.07	A
			Co-60	pCi/L	125	113	1.10	A
			Cr-51	pCi/L	256	239	1.07	A
			Cs-134	pCi/L	112	114	0.99	A
			Cs-137	pCi/L	107	98.8	1.08	A
			Fe-59	pCi/L	95.9	86.0	1.12	A
			I-131	pCi/L	69.8	71.9	0.97	A
			Mn-54	pCi/L	138	130	1.06	A
			Zn-65	pCi/L	186	157	1.18	A
	E12207	Charcoal	I-131	pCi	69.6	72.2	0.96	A
	E12208	AP	Ce-141	pCi	151	165	0.92	A
			Co-58	pCi	174	178	0.98	A
			Co-60	pCi	290	227	1.28	W
			Cr-51	pCi	452	478	0.95	A
			Cs-134	pCi	215	227	0.95	A
			Cs-137	pCi	206	198	1.04	A
			Fe-59	pCi	180	172	1.05	A
			Mn-54	pCi	265	260	1.02	A
			Zn-65	pCi	280	315	0.89	A
	E12209	Water	Fe-55	pCi/L	1790	1740	1.03	A
	E12210	AP	Sr-89	pCi	77.8	90.3	0.86	A
			Sr-90	pCi	9.54	12.2	0.78	W

(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.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)
September 2018	E12271	Milk	Sr-89	pCi/L	79.4	81.7	0.97	A
			Sr-90	pCi/L	12.2	14.8	0.82	A
	E12272	Milk	Ce-141	pCi/L	152	128	1.19	A
			Co-58	pCi/L	161	144	1.12	A
			Co-60	pCi/L	208	190	1.10	A
			Cr-51	pCi/L	244	265	0.92	A
			Cs-134	pCi/L	124	123	1.01	A
			Cs-137	pCi/L	166	147	1.13	A
			Fe-59	pCi/L	158	119	1.32	N(1)
			I-131	pCi/L	83.1	58.2	1.43	N(2)
			Mn-54	pCi/L	191	167	1.14	A
			Zn-65	pCi/L	229	201	1.14	A
	E12273	Charcoal	I-131	pCi	83.0	80.7	1.03	A
	E12274	AP	Ce-141	pCi	101	85.6	1.18	A
			Co-58	pCi	92.7	96.0	0.97	A
			Co-60	pCi	142	127	1.12	A
			Cr-51	pCi	218	177	1.23	W
			Cs-134	pCi	81.2	81.9	0.99	A
			Cs-137	pCi	99.0	98.5	1.01	A
			Fe-59	pCi	93.7	79.7	1.18	A
			Mn-54	pCi	116	112	1.04	A
			Zn-65	pCi	139	134	1.04	A
	E12302	Water	Fe-55	pCi/L	2120	1820	1.17	A
	E12276	Soil	Ce-141	pCi/g	0.259	0.221	1.17	A
			Co-58	pCi/g	0.279	0.248	1.12	A
			Co-60	pCi/g	0.367	0.328	1.12	A
			Cr-51	pCi/g	0.597	0.457	1.31	N (3)
			Cs-134	pCi/g	0.261	0.212	1.23	W
			Cs-137	pCi/g	0.376	0.330	1.14	A
			Fe-59	pCi/g	0.248	0.206	1.20	A
			Mn-54	pCi/g	0.317	0.289	1.10	A
			Zn-65	pCi/g	0.407	0.347	1.17	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

(1) See ***NCR 18-20***
(2) See ***NCR 18-24***
(3) See ***NCR 18-21***

TABLE D.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)]
December 2018	E12313	Milk	Sr-89	pCi/L	71.9	91.9	0.78	W
			Sr-90	pCi/L	12.1	13.3	0.91	A
	E12314	Milk	Ce-141	pCi/L	124	133	0.93	A
			Co-58	pCi/L	110	119	0.93	A
			Co-60	pCi/L	202	212	0.95	A
			Cr-51	pCi/L	292	298	0.98	A
			Cs-134	pCi/L	146	171	0.85	A
			Cs-137	pCi/L	118	121	0.98	A
			Fe-59	pCi/L	120	114	1.05	A
			I-131	pCi/L	94.2	93.3	1.01	A
			Mn-54	pCi/L	151	154	0.98	A
			Zn-65	pCi/L	266	264	1.01	A
	E12315	Charcoal	I-131	pCi	94.8	89.9	1.05	A
	E12316A	AP	Ce-141	pCi	92.3	94.0	0.98	A
			Co-58	pCi	73.4	83.8	0.88	A
			Co-60	pCi	137	150	0.91	A
			Cr-51	pCi	202	210	0.96	A
			Cs-134	pCi	115	121	0.95	A
			Cs-137	pCi	85.0	85.4	1.00	A
			Fe-59	pCi	83.1	80.8	1.03	A
			Mn-54	pCi	104	109	0.96	A
			Zn-65	pCi	168	187	0.90	A
	E12317	Water	Fe-55	pCi/L	2110	1840	1.15	A
	E12318	AP	Sr-89	pCi	81.1	83.0	0.98	A
			Sr-90	pCi	11.4	12.0	0.95	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.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 2018	18-MaS38	Soil	Ni-63	Bq/kg	9.94		*(1)*	A
			Sr-90	Bq/kg	0.846		*(1)*	A
	18-MaW38	Water	Am-241	Bq/L	0.785	0.709	0.496 - 0.922	A
			Ni-63	Bq/L	12.6	14.0	9.8 - 18.2	A
			Pu-238	Bq/L	0.0214	0.023	*(2)*	A
			Pu-239/240	Bq/L	0.544	0.600	0.420 - 0.780	A
	18-RdF38	AP	U-234/233	Bq/sample	0.111	0.124	0.087 - 0.161	A
			U-238	Bq/sample	0.123	0.128	0.090 - 0.166	A
	18-RdV38	Vegetation	Cs-134	Bq/sample	2.46	3.23	2.26 - 4.20	W
			Cs-137	Bq/sample	3.14	3.67	2.57 - 4.77	A
			Co-57	Bq/sample	4.12	4.42	3.09 - 5.75	A
			Co-60	Bq/sample	1.86	2.29	1.60 - 2.98	A
			Mn-54	Bq/sample	2.21	2.66	1.86 - 3.46	A
			Sr-90	Bq/sample				NR(3)
			Zn-65	Bq/sample	-0.201		*(1)*	A
November 2018	18-MaS39	Soil	Ni-63	Bq/kg	703	765	536 - 995	A
			Sr-90	Bq/kg	137	193	*135 - 251*	W
	18-MaW39	Water	Am-241	Bq/L	0.0363		*(1)*	A
			Ni-63	Bq/L	6.18	7.0	4.9 - 9.1	A
			Pu-238	Bq/L	0.73	0.674	0.472 - 0.876	A
			Pu-239/240	Bq/L	0.89	0.928	0.650 - 1.206	A
	18-RdF39	AP	U-234/233	Bq/sample	0.159	0.152	0.106 - 0.198	A
			U-238	Bq/sample	0.162	0.158	0.111 - 0.205	A
	18-RdV39	Vegetation	Cs-134	Bq/sample	1.85	1.94	1.36 - 2.52	A
			Cs-137	Bq/sample	2.5	2.36	1.65 - 3.07	A
			Co-57	Bq/sample	3.53	3.31	2.32 - 4.30	A
			Co-60	Bq/sample	1.6	1.68	1.18 - 2.18	A
			Mn-54	Bq/sample	2.61	2.53	1.77 - 3.29	A
			Sr-90	Bq/sample	0.338	0.791	0.554 - 1.028	N(4)
			Zn-65	Bq/sample	1.32	1.37	*0.96 - 1.78*	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 18-09***

*(4) See **NCR 18-25***

TABLE D.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 2018	MRAD-28	AP	GR-A	pCi/sample	65.7	43.4	22.7 - 71.5	A
			GR-B	pCi/sample	57.2	52	31.5 - 78.6	A
April 2018	RAD-113	Water	Ba-133	pCi/L	91.2	91.5	77.1 - 101	A
			Cs-134	pCi/L	70.4	75.9	62.0 - 83.5	A
			Cs-137	pCi/L	122	123	111 - 138	A
			Co-60	pCi/L	64.8	64.3	57.9 - 73.2	A
			Zn-65	pCi/L	98.6	86.7	78.0 - 104	A
			GR-A	pCi/L	32.8	28.6	14.6 - 37.5	A
			GR-B	pCi/L	62.9	73.7	51.4 - 81.1	A
			U-Nat	pCi/L	6.7	6.93	5.28 - 8.13	A
			H-3	pCi/L	17100	17200	15000 - 18900	A
			Sr-89	pCi/L	38.6	48.8	38.3 - 56.2	A
			Sr-90	pCi/L	27.1	26.5	19.2 - 30.9	A
			I-131	pCi/L	26.7	24.6	20.4 - 29.1	A
September 2018	MRAD-29	AP	GR-A	pCi/sample	49.7	55.3	28.9 - 91.1	A
		AP	GR-B	pCi/sample	75.3	86.5	52.4 - 131	A
October 2018	RAD-115	Water	Ba-133	pCi/L	15.2	16.3	11.9 - 19.4	A
			Cs-134	pCi/L	85.9	93.0	76.4 - 102	A
			Cs-137	pCi/L	229	235	212 - 260	A
			Co-60	pCi/L	81.9	80.7	72.6 - 91.1	A
			Zn-65	pCi/L	348	336	302 - 392	A
			GR-A	pCi/L	38.9	60.7	31.8 - 75.4	A
			GR-B	pCi/L	36.5	41.8	27.9 - 49.2	A
			U-Nat	pCi/L	17.48	20.9	16.8 - 23.4	A
			H-3	pCi/L	2790	2870	2410 - 3170	A
			I-131	pCi/L	26.9	27.2	22.6 - 32.0	A
			Sr-89	pCi/L	57.2	56.9	45.5 - 64.6	A
			Sr-90	pCi/L	36.8	31.4	22.9- 36.4	N[(1)]

(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 18-23***

(Page 1 of 1)

APPENDIX E

ERRATA DATA

Intentionally left blank

There was no errata data for 2018

Intentionally left blank

APPENDIX F

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally left blank

ARGPPR Table Of Contents

ARGPPR Appendices

I. Summary and Conclusions

In 2006, Exelon instituted a comprehensive program to evaluate the impact of station operations on groundwater and surface water in the vicinity of Clinton Power Station (CPS). This evaluation involved numerous station personnel and contractor support personnel. This report covers groundwater and surface water samples, collected outside of the Licensee required Off-Site Dose Calculation Manual (ODCM) requirements, both on and off station property in 2018. During that time period, 236 analyses were performed on 102 samples from 33 locations. The monitoring was conducted in four phases.

In assessing all the data gathered for this report, it was concluded that the operation of CPS had no adverse radiological impact on the environment, and there are no known active releases into the groundwater or surface water at CPS. No program changes occurred during the sampling year of 2018.

Gamma-emitting radionuclides associated with licensed plant operations were not detected at concentrations greater than their respective Lower Limits of Detection (LLDs) as specified in NUREG-1302 in any of the groundwater or surface water samples. In the case of tritium, Exelon specified that the independent laboratory achieve a lower limit of detection ten times lower than that required by the United States Environmental Protection Agency (USEPA) regulation.

Strontium-89 (Sr-89) was not detected in any samples. Strontium-90 (Sr-90) was not detected in any samples.

Tritium was not detected in any of the groundwater or surface water samples at concentrations greater than the United States Environmental Protection Agency (USEPA) drinking water standard (and the Nuclear Regulatory Commission Reporting Limit) of 20,000 pCi/L. Background levels of tritium were detected at concentrations greater than the self-imposed LLD of 200 pCi/L in five of seventeen groundwater monitoring locations. The tritium concentrations ranged from 245 ± 122 pCi/L to 840 ± 151 pCi/L. Tritium was not detected in any surface water samples.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during the third quarter of sampling in 2018. Gross Alpha (dissolved and suspended) was not detected at any of the groundwater locations. Gross Beta (dissolved) was detected in twelve of seventeen groundwater locations. The concentrations ranged from 1.9 to 17.6 pCi/L. Gross Beta (suspended) was not detected at any of the groundwater locations.

Hard-To-Detect analyses were performed on two groundwater locations. The analyses included Iron-55 (Fe-55), Nickel-63 (Ni-63), Americium-241 (Am-241), Cerium-242 (Cm-242), Cerium-243/244 (Cm-243/244), Plutonium-238 (Pu-238), Plutonium-239/240 (Pu-239/240), Uranium-234 (U-234), Uranium-235 (U-235) and Uranium-238 (U-238). U-234 and U-238 were detected at one location with concentrations of 0.64 ± 0.25 pCi/L and 0.63 ± 0.25 pCi/L respectively. All other hard-to-detect nuclides analyzed were not found at concentrations greater than their respective MDCs.

II. Introduction

The Clinton Power Station (CPS), consisting of one approximately 1,140 MW gross electrical power output boiling water reactor is located in Harp Township, DeWitt County, Illinois. CPS is owned and operated by Exelon and became operational in 1987. Unit No. 1 went critical on February 27, 1987. The site encloses approximately 13,730 acres. This includes the 4,895 acre, man-made cooling lake and about 452 acres of property not owned by Exelon. The plant is situated on approximately 150 acres. The cooling water discharge flume, which discharges to the eastern arm of the lake, occupies an additional 130 acres. Although the nuclear reactor, supporting equipment and associated electrical generation and distribution equipment lie in Harp Township, portions of the aforementioned 13,730 acre plot reside within Wilson, Rutledge, DeWitt, Creek, Nixon and Santa Anna Townships.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) on samples collected in 2018.

A. Objectives of the Radiological Groundwater Protection Program (RGPP)

The long-term objectives of the RGPP are as follows:

1. Identify suitable locations to monitor and evaluate potential impacts from station operations before significant radiological impact to the environment and potential drinking water sources.

2. Understand the local hydrogeologic regime in the vicinity of the station and maintain knowledge of flow patterns on the surface and shallow subsurface.

3. Perform routine water sampling and radiological analysis of water from selected locations.

4. Report new leaks, spills, or other detections with potential radiological significance to stakeholders in a timely manner.

5. Regularly assess analytical results to identify adverse trends.

6. Take necessary corrective actions to protect groundwater resources.

B. Implementation of the Objectives

The objectives identified have been implemented at Clinton Power Station as discussed below:

1. Exelon and its consultant identified locations as described in the Phase 1 study. Phase 1 studies were conducted by Connestoga Rovers and Associates (CRA) and the results and conclusions were made available to state and federal regulators as well as the public in station specific reports.

2. The Clinton Power Station reports describe the local hydrogeologic regime. Periodically, the flow patterns on the surface and shallow subsurface are updated based on ongoing measurements.

3. Clinton Power Station will continue to perform routine sampling and radiological analysis of water from selected locations.

4. Clinton Power Station has procedures to identify and report new leaks, spills, or other detections with potential radiological significance in a timely manner.

5. Clinton Power Station staff and consulting hydrogeologist assess analytical results on an ongoing basis to identify adverse trends.

C. Program Description

1. Sample Collection

Sample locations can be found in Table A–1 and Figures A–1, A–2, A–3, and A–4 Appendix A.

Groundwater, Surface Water and Precipitation Water

Samples of water are collected, managed, transported and analyzed in accordance with approved procedures following regulatory methods. Groundwater, surface water, and precipitation water are collected. Sample locations, sample collection frequencies and analytical frequencies are controlled in accordance with approved station procedures. Contractor and/or station personnel are trained in the collection, preservation management, and shipment of samples, as well as in documentation of sampling events. Analytical laboratories are subject to internal quality assurance programs and inter-laboratory cross-check programs, as well as nuclear industry audits. Station personnel review and evaluate all analytical data deliverables after initial review by the contractor.

Analytical data results are reviewed by both station personnel and an independent hydrogeologist for adverse trends or changes to hydrogeologic conditions.

D. Characteristics of Tritium (H-3)

Tritium (chemical symbol H-3) is a radioactive isotope of hydrogen. The most common form of tritium is tritium oxide, which is also called "tritiated water." The chemical properties of tritium are essentially those of ordinary hydrogen.

Tritiated water behaves the same as ordinary water in both the environment and the body. Tritium can be taken into the body by drinking water, breathing air, eating food, or absorption through skin. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted primarily through urine with a clearance rate characterized by an effective biological half-life of about 14 days. Within one month or so after ingestion, essentially all tritium is cleared. Organically bound tritium (tritium that is incorporated in organic compounds) can remain in the body for a longer period.

Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Tritium is also produced during nuclear weapons explosions, as a by-product in reactors producing electricity, and in special production reactors, where the isotopes Lithium-7 (Li-7) and/or Boron-10 (B-10) are activated to produce tritium. Like normal water, tritiated water is colorless and odorless. Tritiated water behaves chemically and physically like non-tritiated water in the subsurface, and therefore tritiated water will travel at the same velocity as the average groundwater velocity.

Tritium has a half-life of approximately 12.3 years. It decays spontaneously to Helium-3 (3He). This radioactive decay releases a beta particle (low-energy electron). The radioactive decay of tritium is the source of the health risk from exposure to tritium. Tritium is one of the least dangerous radionuclides because it emits very weak beta radiation and leaves the body relatively quickly. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues is generally uniform and is dependent on the water content of the specific tissue.

III. Program Description

A. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the Clinton

Power Station RGPP in 2018. In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of gamma emitters in groundwater and surface water

2. Concentrations of strontium in groundwater

3. Concentrations of tritium in groundwater, surface water and precipitation samples

4. Concentrations of gross alpha and gross beta in groundwater

5. Concentrations of Am-241 in groundwater

6. Concentrations of Cm-242 and Cm-243/244 in groundwater

7. Concentrations of Pu-238 and Pu-239/240 in groundwater

8. Concentrations of U-234, U-235 and U-238 in groundwater

9. Concentrations of Fe-55 in groundwater

10. Concentrations of Ni-63 in groundwater

B. Data Interpretation

The radiological data collected prior to Clinton Power Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Clinton Power Station was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. <u>Lower Limit of Detection and Minimum Detectable Concentration</u>

The lower limit of detection (LLD) is 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 is intended as an *a priori* (a before the fact) estimate of a system (including instrumentation, procedure and sample type) and not as an *a posteriori* (after the fact) criteria for the presence of activity. All analyses were designed to achieve the required CPS detection capabilities for environmental sample analysis.

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

2. Laboratory Measurements Uncertainty

The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value. Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. Exelon reports the uncertainty of a measurement created by statistical process (counting error) as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. Exelon reports the TPU by following the result with plus or minus ± the estimated sample standard deviation, as TPU, that is obtained by propagating all sources of analytical uncertainty in measurements.

Analytical uncertainties are reported at the 95% confidence level in this report for reporting consistency with the AREOR.

C. Background Analysis

Pre-operational Radiological Environmental Monitoring Program (pre-operational REMP) was conducted to establish background radioactivity levels prior to operation of the Station. The environmental media sampled and analyzed during the pre-operational REMP were atmospheric radiation, fall-out, domestic water, surface water, marine life, milk, and vegetation. The results of the monitoring were detailed in the report entitled, Environmental Radiological Monitoring for Clinton Power Nuclear Power Station, Illinois Power Company, Annual Report 1987, May 1988.

The pre-operational REMP contained analytical results from samples collected from the surface water and groundwater.

1. Background Concentrations of Tritium

The purpose of the following discussion is to summarize background measurements of tritium in various media performed by others:

a. Tritium Production

Tritium is created in the environment from naturally-occurring processes both cosmic and subterranean, as well as from anthropogenic (i.e., man-made) sources. In the upper atmosphere, "Cosmogenic" tritium is produced from the bombardment of stable nuclides and combines with oxygen to form tritiated water, which will then enter the hydrologic cycle. Below ground, "lithogenic" tritium is produced by the bombardment of natural lithium present in crystalline rocks by neutrons produced by the radioactive decay of naturally abundant uranium and thorium. Lithogenic production of tritium is usually negligible compared to other sources due to the limited abundance of lithium in rock. The lithogenic tritium is introduced directly to groundwater.

A major anthropogenic source of tritium and Sr-90 comes from the former atmospheric testing of thermonuclear weapons. Levels of tritium in precipitation increased significantly during the 1950s and early 1960s, and later with additional testing, resulting in the release of significant amounts of tritium to the atmosphere. The Canadian heavy water nuclear power reactors, other commercial power reactors, nuclear research and weapons production continue to influence tritium concentrations in the environment.

b. Precipitation Data

Precipitation samples are routinely collected at stations around the world for the analysis of tritium and other radionuclides. Two publicly available databases that provide tritium concentrations in precipitation are Global Network of Isotopes in Precipitation (GNIP) and USEPA's RadNet database. GNIP provides tritium precipitation concentration data for samples collected world wide from 1960 to 2006. RadNet provides tritium precipitation concentration data for samples collected at stations through out the U.S. from 1960 up to and including 2006. Based on GNIP data for sample stations located in the U.S. Midwest, tritium concentrations peaked around 1963. This peak, which approached 10,000 pCi/L for some stations, coincided with the atmospheric testing of thermonuclear weapons. Tritium concentrations in surface water showed a sharp decline up until 1975, followed by a gradual decline since that time. Tritium concentrations in Midwest precipitation have typically been below 100 pCi/L since around 1980. Tritium concentrations in wells may still be above the 200 pCi/L detection limit from the external causes described above.

c. Surface Water Data

Tritium concentrations are routinely measured in Clinton Lake.

According to the USEPA, surface water data typically has an uncertainty ± 70 to 100 pCi/L 95% confidence bound on each given measurement. Therefore, the typical background data provided may be subject to measurement uncertainty of approximately ± 70 to 100 pCi/L.

The radio-analytical laboratory is counting tritium results to an Exelon specified LLD of 200 pCi/L. Typically, the lowest positive measurement will be reported within a range of 40 – 240 pCi/L or 140 ± 100 pCi/L. Clearly, these sample results cannot be distinguished as different from background at this concentration.

IV. Results and Discussion

A. Program Exceptions

1. Sample Anomalies

IR 4188917 RGPP: Vendor Failed to Reach LLD per EN-AA-408-4000:

Table 1 in Attachment 5 of EN-AA-408-4000 indicates the LLD for the annual dissolved gross alpha in Clinton's Monitoring Wells to be 3 pCi/L. The sampling and analysis of dissolved gross alpha in the Monitoring Wells is contracted out to Teledyne Brown Engineering (TBE). TBE identified a discrepancy during their review of the analytical results from 3Q18 and notified the station that they could not reach EN-AA-408-4000's MDC in Monitoring Well MW-CL-19S due to high solid content in the samples. The vendor extended the count time to 200 minutes to achieve the lowest possible MDC, but were only capable of obtaining a MDC of 4.38E+00 pCi/L.

2. Missed Samples

There were no missed samples in 2018.

B. Program Changes

There were no program changes in 2018.

C. Groundwater Results

Groundwater

Baseline samples were collected from off-site wells during four (4) phases at the station. Analytical results are discussed below:

Tritium

Samples from seventeen locations were analyzed for tritium activity (Table B–I.1 Appendix B). Tritium values ranged from below the Exelon-imposed LLD of 200 pCi/l to 840 pCi/l.

Strontium

Sr-89 was not detected in any of the seventeen samples analyzed and the required LLD of 10 pCi/L was met. Sr-90 was also not detected in any of the seventeen samples analyzed and the required LLD of 1 pCi/L was met. (Table B-I.1 Appendix B)

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during the third quarter of sampling in 2018. Gross Alpha (dissolved and suspended) was not detected at any of the groundwater locations. Gross Beta (dissolved) was detected in twelve of seventeen groundwater locations. The concentrations ranged from 1.9 to 17.6 pCi/L. Gross Beta (suspended) was not detected at any of the groundwater locations.
(Table B–I.1 Appendix B)

Gamma Emitters

No plant-produced radionuclides were detected.
(Table B–I.2, Appendix B)

Hard-To-Detect

Hard-To-Detect analyses were performed on two groundwater locations to establish background levels. The analyses included Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-234, U-235, and U-238. One sample detected U-234 and U-238. Occasionally, the isotopes of U-234 and U-238 are detected at low levels and indistinguishable from background. All other hard-to-detect nuclides were not detected at concentrations greater than their respective MDCs. (Table B–I.3 Appendix B)

D. Surface Water Results

Surface Water

Baseline samples were collected from on-site surface waters during four (4) phases at the station. Analytical results are discussed below. No anomalies were noted during the year.

Tritium

Samples from six locations were analyzed for tritium activity (Table B–II.1 Appendix B). Tritium was not detected at concentrations greater than the LLD.

Gamma Emitters

No plant-produced radionuclides were detected.
(Table B–II.2, Appendix B)

E. Precipitation Water Results (Recapture)

Precipitation water samples from 10 locations were analyzed for tritium activity. Tritium was detected in one sample at a concentration of 224 ± 144 pCi/L. (Table B-III.1, Appendix B)

F. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE are presented in Section IV, Part G in the Annual Radiological Environmental Operating Report.

G. Errata Data

There was no Errata Data for 2018.

H. Leaks, Spills, and Releases

There were no leaks, spills or releases in 2018.

I. Trends

No trends have been identified in 2018.

J. Investigations

Currently no investigations are on-going.

K. Actions Taken

1. Compensatory Actions

   There have been no station events requiring compensatory actions at the Clinton Power Station in 2018.

2. Installation of Monitoring Wells

   No new wells were installed during the 2018.

3. Actions to Recover/Reverse Plumes

   No actions were required to recover or reverse groundwater plumes.

APPENDIX A

LOCATION DESIGNATION OF THE ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally Left Blank

TABLE A-1: Radiological Groundwater Protection Program - Sampling Locations, Clinton Power Station, 2018

Site	Site Type
B-3	Monitoring Well
MW-1	Monitoring Well
MW-2	Monitoring Well
MW-CL-12I	Monitoring Well
MW-CL-13I	Monitoring Well
MW-CL-13S	Monitoring Well
MW-CL-14S	Monitoring Well
MW-CL-15I	Monitoring Well
MW-CL-15S	Monitoring Well
MW-CL-16S	Monitoring Well
MW-CL-17S	Monitoring Well
MW-CL-18I	Monitoring Well
MW-CL-18S	Monitoring Well
MW-CL-19S	Monitoring Well
MW-CL-20S	Monitoring Well
MW-CL-21S	Monitoring Well
MW-CL-22S	Monitoring Well
SW-CL-1	Surface Water
SW-CL-2	Surface Water
SW-CL-4	Surface Water
SW-CL-5	Surface Water
SW-CL-6	Surface Water
SW-CL-7	Surface Water
RG-2	Precipitation Water
RG-3	Precipitation Water
RG-15	Precipitation Water
RG-ENE	Precipitation Water
RG-N	Precipitation Water
RG-NNE	Precipitation Water
RG-NNW	Precipitation Water
RG-NW	Precipitation Water
RG-S	Precipitation Water
RG-WNW	Precipitation Water

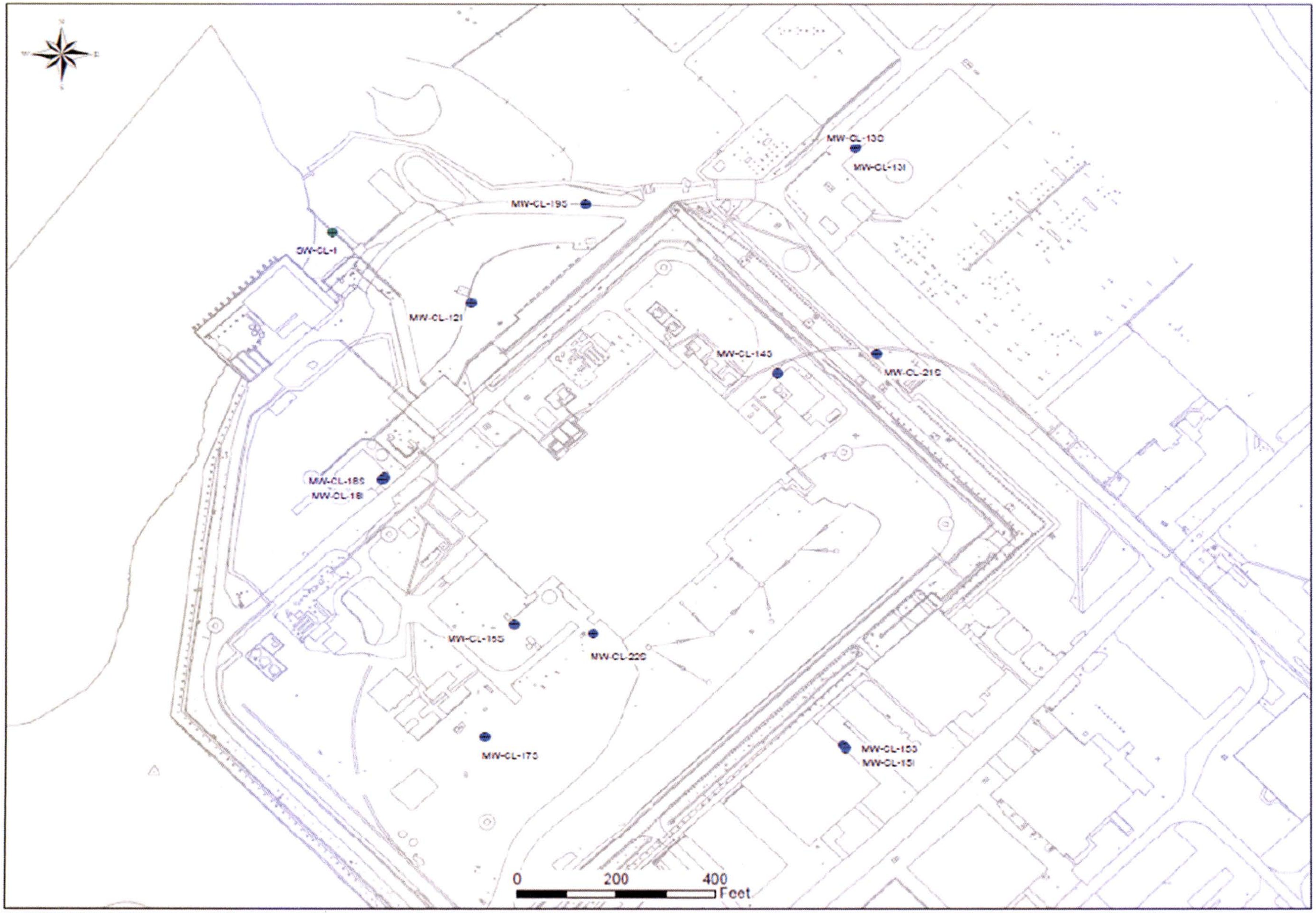


Figure A – 1
Onsite Sampling Locations at Clinton Power Station

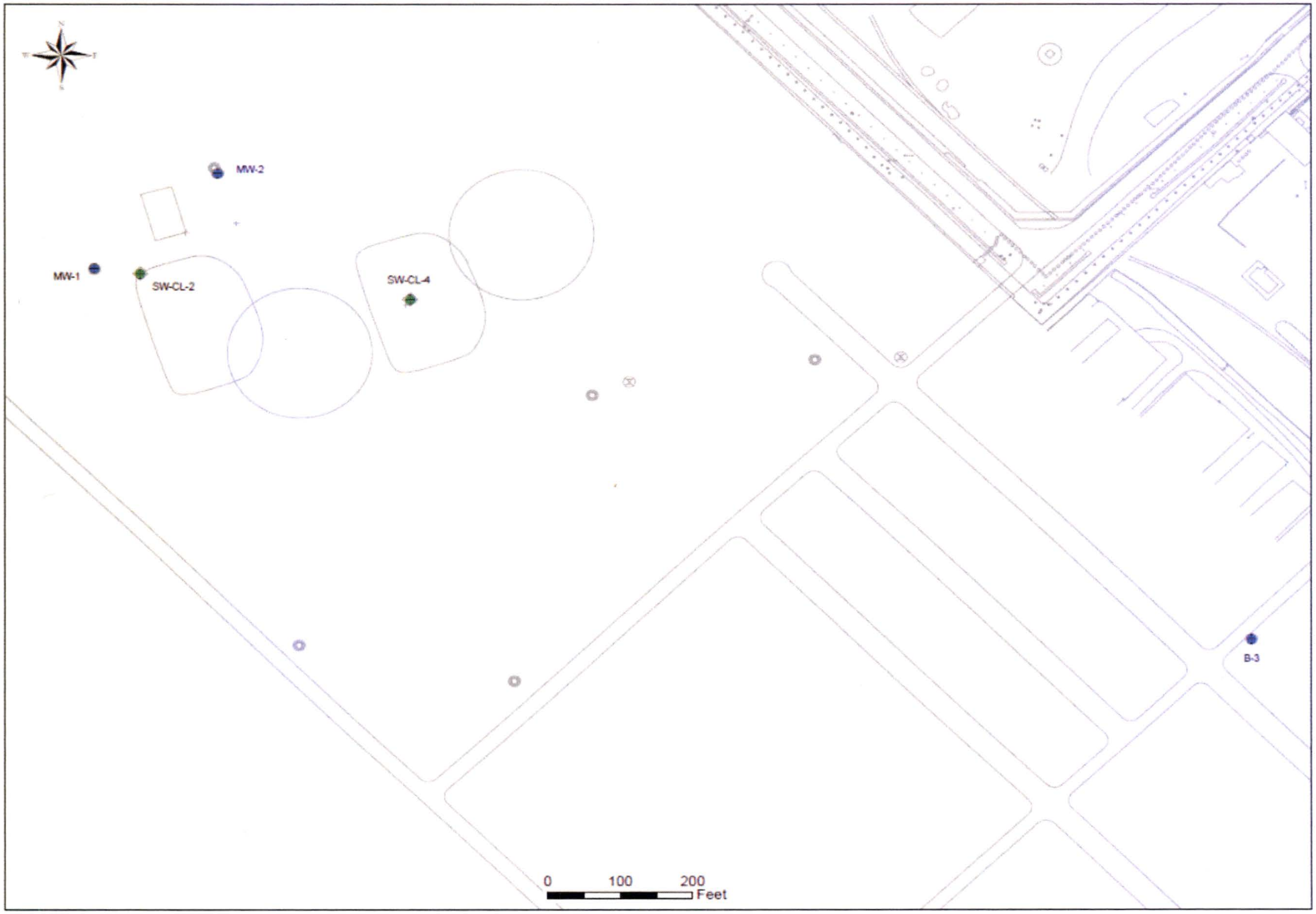


Figure A – 2
Sampling Locations South of Clinton Power Station

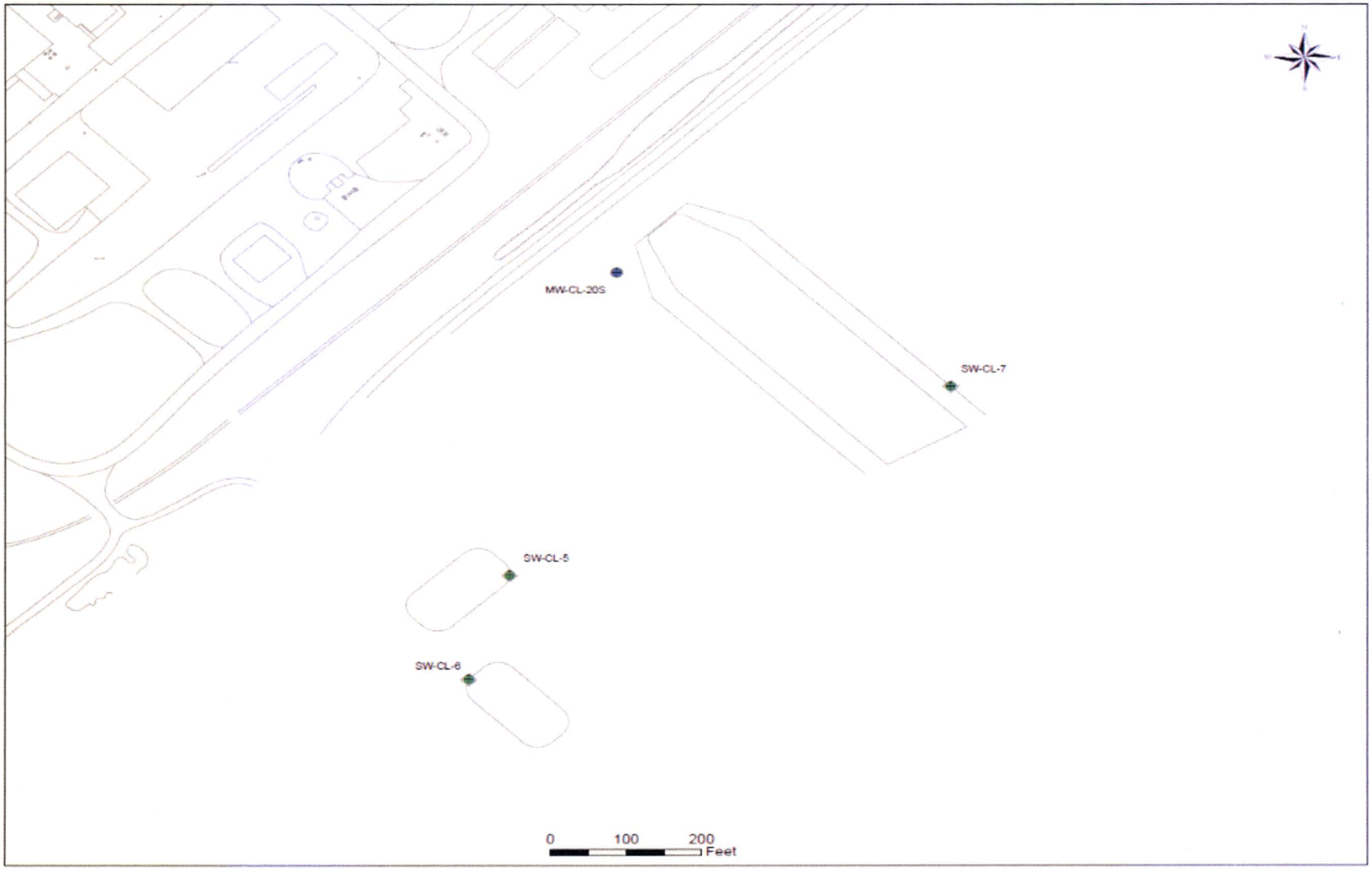


Figure A – 3
Sampling Locations East of Clinton Power Station

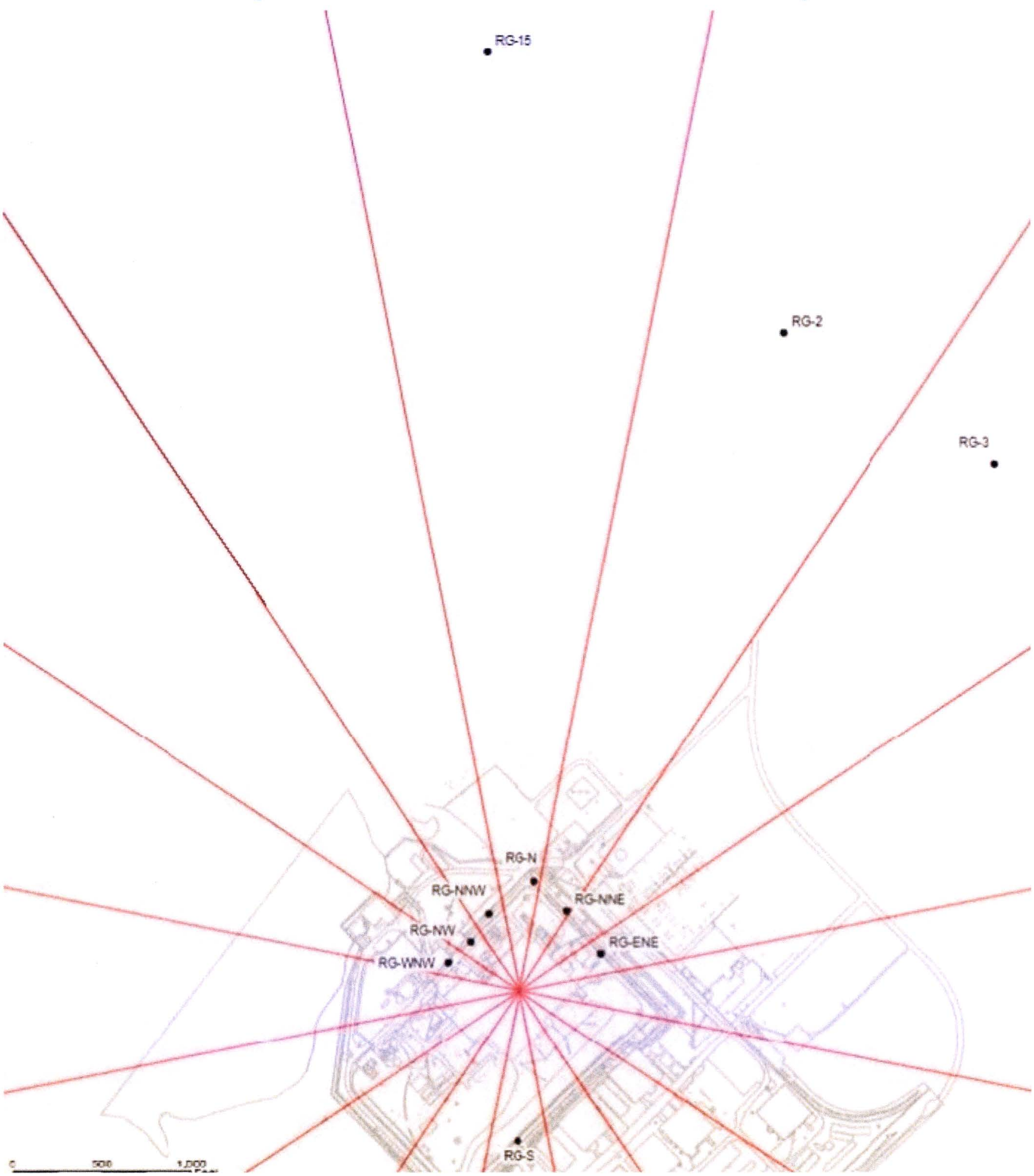


Figure A – 4
Recapture Sampling Locations of Clinton Power Station

Intentionally Left Blank

APPENDIX B

DATA TABLES OF THE ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally left blank

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
B-3	01/24/18	< 192						
B-3	05/10/18	< 181						
B-3	09/12/18	< 197	< 4.5	< 0.5	< 1.5	< 1.4	2.1 ± 1.1	< 1.9
B-3	10/31/18	< 192						
MW-CL-1	01/24/18	< 193						
MW-CL-1	05/10/18	< 184						
MW-CL-1	09/12/18	< 196	< 6.5	< 1.0	< 1.3	< 0.5	1.9 ± 0.9	< 1.3
MW-CL-1	10/31/18	< 194						
MW-CL-2	01/24/18	< 193						
MW-CL-2	05/10/18	< 180						
MW-CL-2	09/12/18	< 195	< 7.4	< 0.8	< 1.6	< 0.5	2.5 ± 1.1	< 1.3
MW-CL-2	10/31/18	< 196						
MW-CL-12I	01/25/18	< 177						
MW-CL-12I	05/10/18	< 181						
MW-CL-12I	09/13/18	< 194	< 4.2	< 0.7	< 1.3	< 0.5	3.2 ± 1.0	< 1.3
MW-CL-12I	10/31/18	< 194						
MW-CL-13I	01/24/18	< 192						
MW-CL-13I	05/10/18	< 178						
MW-CL-13I	09/12/18	< 195	< 7.1	< 0.9	< 1.4	< 0.5	< 1.5	< 1.3
MW-CL-13I	10/31/18	< 199						
MW-CL-13S	01/24/18	< 193						
MW-CL-13S	05/10/18	245 ± 122						
MW-CL-13S	09/12/18	< 200	< 4.9	< 0.9	< 0.9	< 0.5	< 1.5	< 1.3
MW-CL-13S	10/31/18	< 197						
MW-CL-14S	01/25/18	392 ± 131						
MW-CL-14S	05/11/18	840 ± 151						
MW-CL-14S	09/13/18	517 ± 145	< 4.6	< 0.5	< 2.4	< 0.5	9.8 ± 1.7	< 1.3
MW-CL-14S	11/01/18	422 ± 141						
MW-CL-15I	01/24/18	< 195						
MW-CL-15I	05/10/18	< 180						
MW-CL-15I	09/12/18	< 197	< 4.3	< 0.6	< 0.9	< 1.3	< 1.4	< 1.9
MW-CL-15I	10/31/18	< 197						
MW-CL-15S	01/24/18	< 196						
MW-CL-15S	05/10/18	< 182						
MW-CL-15S	09/12/18	< 195	< 5.4	< 0.7	< 0.5	< 0.8	< 0.9	< 2.2
MW-CL-15S	10/31/18	< 198						
MW-CL-16S	01/25/18	< 193						
MW-CL-16S	05/11/18	< 180						
MW-CL-16S	09/13/18	< 188	< 4.5	< 0.5	< 0.8	< 0.7	4.6 ± 1.0	< 2.2
MW-CL-16S	11/01/18	< 197						
MW-CL-17S	01/25/18	< 192						
MW-CL-17S	05/11/18	< 181						
MW-CL-17S	09/13/18	< 198	< 3.8	< 0.6	< 2.2	< 0.5	4.5 ± 1.5	< 1.5
MW-CL-17S	11/01/18	< 197						
MW-CL-18I	01/25/18	< 191						
MW-CL-18I	05/11/18	< 179						
MW-CL-18I	09/13/18	< 197	< 3.4	< 0.5	< 1.5	< 0.5	3.3 ± 1.1	< 1.5
MW-CL-18I	11/01/18	< 193						

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-CL-18S	01/25/18	< 194						
MW-CL-18S	05/11/18	< 181						
MW-CL-18S	09/13/18	< 197	< 8.2	< 0.7	< 2.7	< 0.5	4.0 ± 1.4	< 1.5
MW-CL-18S	11/01/18	< 174						
MW-CL-19S	01/25/18	< 176						
MW-CL-19S	05/10/18	< 182						
MW-CL-19S	09/13/18	< 193	< 6.7	< 0.8	< **4.4**	< 0.5	5.6 ± 1.6	< 1.5
MW-CL-19S	10/31/18	< 198						
MW-CL-20S	01/24/18	< 191						
MW-CL-20S	05/10/18	< 183						
MW-CL-20S	09/12/18	< 190	< 6.8	< 0.7	< 2.1	< 0.5	2.1 ± 1.2	< 1.5
MW-CL-20S	10/31/18	< 200						
MW-CL-21S	01/25/18	< 194						
MW-CL-21S	05/10/18	< 177						
MW-CL-21S	09/14/18	< 195	< 4.4	< 0.8	< 1.4	< 0.5	< 1.4	< 1.5
MW-CL-21S	10/31/18	< 197						
MW-CL-22S	01/25/18	< 188						
MW-CL-22S	05/11/18	< 174						
MW-CL-22S	09/13/18	< 196	< 7.6	< 0.6	< 2.3	< 0.5	17.6 ± 1.8	< 1.5
MW-CL-22S	11/01/18	< 198						

Bolded values indicate LLD was not met due to high solids content in the sample (see program exceptions)

Table B-I.2

CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
B-3	09/12/18	< 21	< 21	< 2	< 2	< 5	< 2	< 5	< 3	< 5	< 2	< 2	< 16	< 5
MW-1	09/12/18	< 23	< 22	< 2	< 2	< 5	< 2	< 5	< 3	< 4	< 3	< 2	< 16	< 6
MW-2	09/12/18	< 16	< 17	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 4
MW-CL-12I	09/13/18	< 19	< 18	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 14	< 5
MW-CL-13I	09/12/18	< 8	< 24	< 1	< 1	< 2	< 1	< 2	< 1	< 2	< 1	< 1	< 7	< 2
MW-CL-13S	09/12/18	< 15	< 30	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 4
MW-CL-14S	05/11/18	< 27	< 51	< 3	< 3	< 7	< 3	< 5	< 3	< 6	< 3	< 3	< 15	< 5
MW-CL-14S	09/13/18	< 15	< 25	< 1	< 2	< 3	< 2	< 3	< 2	< 3	< 2	< 2	< 13	< 4
MW-CL-15I	09/12/18	< 16	< 16	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 5
MW-CL-15S	09/12/18	< 18	< 36	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 2	< 2	< 14	< 5
MW-CL-16S	09/13/18	< 15	< 26	< 1	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 13	< 4
MW-CL-17S	09/13/18	< 14	< 32	< 1	< 1	< 3	< 1	< 3	< 2	< 3	< 2	< 1	< 12	< 4
MW-CL-18I	09/13/18	< 16	< 17	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 14	< 5
MW-CL-18S	09/13/18	< 8	< 22	< 1	< 1	< 2	< 1	< 2	< 1	< 2	< 1	< 1	< 7	< 2
MW-CL-19S	09/13/18	< 11	< 11	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 1	< 1	< 10	< 3
MW-CL-20S	09/12/18	< 16	< 28	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 5
MW-CL-21S	05/10/18	< 34	< 100	< 4	< 5	< 8	< 5	< 11	< 4	< 7	< 4	< 5	< 21	< 8
MW-CL-21S	09/14/18	< 41	< 36	< 4	< 4	< 10	< 5	< 9	< 3	< 7	< 4	< 4	< 28	< 13
MW-CL-22S	09/13/18	< 14	< 13	< 1	< 2	< 4	< 1	< 3	< 2	< 3	< 2	< 1	< 13	< 4

TABLE B-I.3

CONCENTRATIONS OF HARD TO DETECTS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Am-241	Cm-242	Cm-243/244	Pu-238	Pu-239/240	U-234	U-235	U-238	Fe-55	Ni-63
MW-CL-14S	09/13/18	< 0.12	< 0.06	< 0.12	< 0.05	< 0.02	0.64 ± 0.25	< 0.09	0.63 ± 0.25	< 180	< 4.8
MW-CL-21S	09/14/18	< 0.20	< 0.12	< 0.19	< 0.02	< 0.07	< 0.20	< 0.07	< 0.05	< 200	< 4.2

TABLE B-II.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
SW-CL-1	01/25/18	< 180
SW-CL-1	05/10/18	< 182
SW-CL-1	09/14/18	< 196
SW-CL-1	10/31/18	< 200
SW-CL-2	01/24/18	< 190
SW-CL-2	05/10/18	< 182
SW-CL-2	09/14/18	< 196
SW-CL-2	10/31/18	< 199
SW-CL-4	01/24/18	< 195
SW-CL-4	05/10/18	< 179
SW-CL-4	09/14/18	< 197
SW-CL-4	10/31/18	< 197
SW-CL-5	01/24/18	< 192
SW-CL-5	05/10/18	< 178
SW-CL-5	09/14/18	< 195
SW-CL-5	10/31/18	< 196
SW-CL-6	01/24/18	< 192
SW-CL-6	05/10/18	< 179
SW-CL-6	09/14/18	< 195
SW-CL-6	10/31/18	< 196
SW-CL-7	01/24/18	< 192
SW-CL-7	05/10/18	< 179
SW-CL-7	09/14/18	< 194
SW-CL-7	10/31/18	< 190

Table B-II.2

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
SW-CL-1	09/14/18	< 19	< 44	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 16	< 6
SW-CL-2	09/14/18	< 19	< 32	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 17	< 6
SW-CL-4	09/14/18	< 18	< 19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 18	< 6
SW-CL-5	09/14/18	< 19	< 34	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 2	< 2	< 17	< 5
SW-CL-6	09/14/18	< 19	52 ± 27	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 2	< 2	< 16	< 6
SW-CL-7	09/14/18	< 26	< 21	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 3	< 3	< 22	< 7

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2018

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
RG-2	12/28/18	< 194
RG-3	12/28/18	< 192
RG-15	12/28/18	< 195
RG-ENE	12/28/18	< 199
RG-N	12/28/18	< 197
RG-NNE	12/28/18	< 196
RG-NNW	12/28/18	< 197
RG-NW	12/28/18	< 199
RG-S	12/28/18	< 193
RG-WNW	12/28/18	224 ± 144