Title:
2020 PICKERING NUCLEAR GROUNDWATER MONITORING PROGRAM RESULTS

2020 Pickering Nuclear Groundwater Monitoring Program Results

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Revision Summary

Revision Number	Date	Comments
R000	2021-03-17	Initial issue.

Executive Summary

Pickering Nuclear Generating Station (PNGS) has a mature and robust groundwater monitoring program in place to address the following primary objectives:

1. Confirm predominant on-site groundwater flow characteristics at the PNGS site;
2. Monitor changes to on-site groundwater quality to ensure timely detection of inadvertent releases to groundwater; and
3. Ensure that there are no adverse off-site impacts from PNGS groundwater.

In 2020, groundwater samples were from a total of 104 sampling locations, however, due to the COVID-19 pandemic, routine sampling was decreased, and some samples could not be collected as planned for the year.

The findings with respect to the above objectives are:

- As a result of the COVID-19 pandemic, the figure for the groundwater contour is not available due to the lack of site data. However, the predominant shallow groundwater flow patterns are expected to remain unchanged in 2020 from the original site groundwater flow interpretations established in 2002. The foundation till drainage system located beneath the Turbine Auxiliary Bay is the lowest groundwater discharge point and forms an artificial hydraulic sink, directing site groundwater away from the lake.

- The groundwater data collected from many of the key areas at PNGS indicate that tritium concentrations have remained constant, which indicate stable environmental performance. There were emerging groundwater issues identified at the Unit 1 and Unit 6 areas in 2020. The corrective actions taken to address the sources at Unit 1 and Unit 6 have been completed. Monitoring will continue in these areas.

- In 2020, due to the COVID-19 pandemic, samples could not be obtained from most of the monitoring locations in the site perimeter area. To exercise due diligence, additional groundwater samples from site perimeter monitoring well locations were taken in Q1 2021, and the results are presented in Section 3.3. Tritium concentrations at the available perimeter groundwater monitoring locations remained low. Municipal drinking water samples collected from surrounding Water Supply Plants, as part of the annual OPG PNGS Environmental Monitoring Program, were well below the Ontario Drinking Water Quality Standard for tritium of 7,000 Bq/L. There were no indications of adverse off-site impacts from PNGS groundwater.

1.0 INTRODUCTION

Ontario Power Generation (OPG), Pickering Nuclear Generating Station (PNGS), has a mature and robust annual groundwater monitoring program in place. The program examines the chemical, radiological and physical characteristics of the groundwater beneath the site.

The specific objectives of this program are:

1. **Objective 1**: Confirm predominant on-site groundwater flow characteristics at the PNGS site;

2. **Objective 2:** Monitor changes to on-site groundwater quality to ensure timely detection of inadvertent releases to groundwater; and

3. **Objective 3:** Ensure that there are no adverse off-site impacts from PNGS groundwater.

This report presents groundwater data collected at PNGS for the period from January 1st to December 31st, 2020.

2.0 2020 PROGRAM DESIGN

The design of the PNGS groundwater monitoring program is risk-based in nature. The 2020 groundwater Sampling and Analysis Plan (SAP) was developed to meet the three objectives listed above.

The methodology used to collect data and subsequently draw conclusions for each objective is discussed in further detail below.

2.1 Objective 1 Methodology

Groundwater flow interpretations for PNGS were first established in 2002. On an annual basis, the SAP requires that a set of water levels be collected from specific groundwater monitoring wells in order to verify that the original interpretations have not changed and that OPG continues to have a sound understanding of groundwater flow patterns at the site. In 2020, due to the lack of site data, the groundwater contour figure is not available. However, no significant changes were expected to the groundwater flow pattern in 2020 when compared with the historical data.

2.2 Objective 2 Methodology

In 2020, as per the SAP, groundwater samples were collected from various locations, including monitoring wells, foundation drains, sumps and groundtubes (104 sampling locations in total). Figure 1 shows these locations. It can be seen that the majority of data was collected from locations near the operating reactors. Refer to Section 7.0 of this report for an understanding of the sampling location nomenclature used in the groundwater program.

The 2020 SAP specified the sampling locations, the frequency of sampling at each location (e.g. quarterly, annually) and the parameters for analysis.

Groundwater samples were collected from the following key areas in 2020:

- Unit 1 to 4 Reactor Buildings (RBs);
- Unit 5 to 8 RBs;
- Irradiated Fuel Bays (IFBs);
- Upgrading Plant Pickering (UPP);
- Emergency Power Generator (EPG) area.

Groundwater samples were collected by qualified OPG chemical technicians. Prior to sample collection, each monitoring well was purged to remove standing water, ensuring that representative groundwater flowed into the well. Collected samples were predominantly analyzed for tritium.

In 2020, no groundwater samples were collected for conventional parameters. Tritium was analyzed by the OPG PNGS Chemistry Laboratory.

The groundwater data generated from the sampling program was subsequently analyzed to either support previous conclusions, identify adverse trends, or demonstrate no significant change.

2.3 Objective 3 Methodology

The 2020 SAP included the sampling of monitoring well clusters at the site boundary in order to confirm that there are no adverse off-site impacts from PNGS groundwater. The site perimeter monitoring well locations were chosen to facilitate the evaluation of both lateral and vertical groundwater quality. The methodology for groundwater collection and analysis, as well as for data evaluation, was the same for the site perimeter wells as what is described above for Objective 2. In 2020, samples could not be obtained from the majority of the site perimeter well locations due to the COVID-19 pandemic. In exercising due diligence, samples were collected in most of the monitoring locations in the site perimeter area in Q1 2021, and the results are presented in Section 3.3.

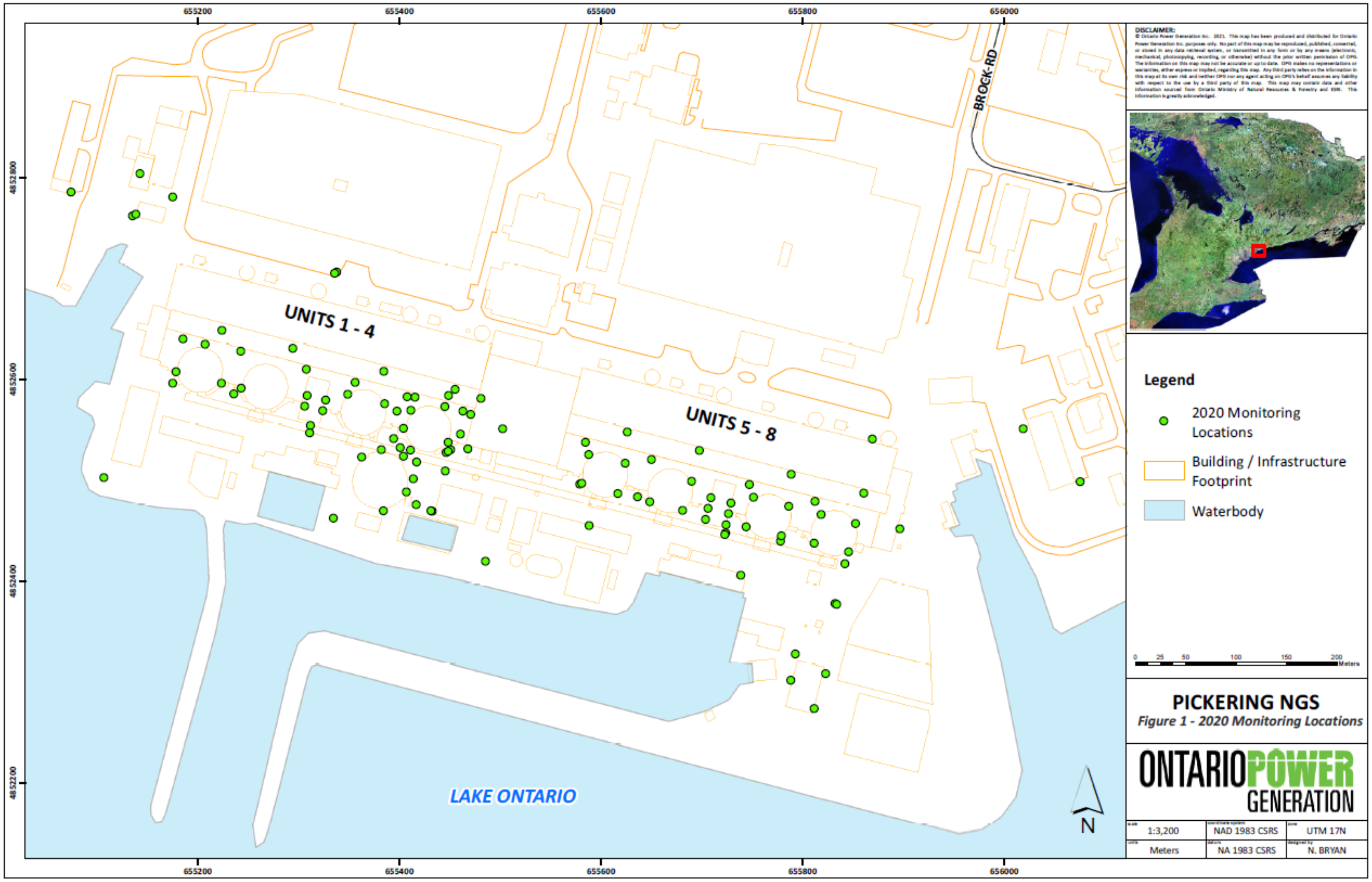


Figure 1 2020 Monitoring Locations

3.0 2020 PROGRAM RESULTS

3.1 Objective 1 Results

In 2020, due to COVID-19 situation, the water contour map could not be generated due to an insufficient number of site data points. It is not believed that any significant changes occurred on the predominant groundwater flow pattern in 2020 when compared with the historical data.

PNGS's groundwater flow systems are categorized into the following four Hydrostratigraphic Units (HU):

- Shallow/Water Table;
- Intermediate Overburden (HU6);
- Deep Overburden (HU7); and
- Deep Bedrock (HU8).

Based on the historical data, the East Landfill (northeast of the PNGS) remains the major local recharge area with groundwater flowing radially from the landfill towards the station buildings to the southwest, and towards the lake in the southeast.

Closer to the reactor units, groundwater flows north towards the Turbine Auxiliary Bay (TAB). The foundation till drainage system located beneath the TAB is the lowest groundwater discharge point and forms an artificial hydraulic sink. The TAB foundation drains collect groundwater and terminate in the TAB Inactive Drainage (IAD) sumps associated with each reactor unit. These sumps also collect other station process water. The combined discharge from the IAD sumps is eventually discharged via a monitored pathway.

The Vacuum Building Ramp Sump (VBRS), located east of the Vacuum Building (VB), also acts as another hydraulic sink, diverting a portion of groundwater in the Unit 1 and 2 areas towards the VBRS. At the extreme south side of the site, there is a small groundwater flow component towards the lake. Vertically, groundwater flows predominantly downward from the water table (shallow groundwater) to the deep overburden bedrock HUs.

3.2 Objective 2 Results

In 2020, the groundwater data collected from many of the key areas at PNGS indicate that tritium concentrations have remained constant, which confirms stable environmental performance. Emerging groundwater issues at the Unit 1 and Unit 6 areas were identified in 2020. The likely sources were determined, and corrective actions were undertaken to address the issues. Further discussion is provided in the section below.

3.2.1 Sampling and Analysis Changes

In 2020, in order to address COVID-19 concerns, the number of personnel present on site was reduced, routine sampling was decreased and some samples could not be collected as planned for the year. The deviations from the SAP were identified as “NA” in the tables of Appendix A, with the exceptions noted as follow:

- U1-RBFD-4 could not be sampled in 2020, as the location was either inaccessible, found to be dry or due to COVID-19 situation.
- RBU6-GT-1 could not be sampled in 2020, as the location was either inaccessible, or due to the COVID-19 situation.
- Samples for MW-302-40, MW-170-25, MW-186-12, MW-075-10 and MW-076-20 were taken in Q2 as opposed to Q1.
- Samples for MW-157-12 and MW-164-13 were taken in Q4 as opposed to Q2.
- IAD-SU-1 could not be sampled in 2020 Q2 and Q3 because the area was inaccessible.
- RBU3-GT-3 or RBU3-GT-4 could not be sampled in 2020 Q3 because the groundtubes were found to be dry.
- RBU3-GT-3 or RBU3-GT-4, RBU4-GT-1 or RBU4-GT-2, RBU4-GT-3 or RBU4-GT-4 and U5 MK 26 could not be sampled in 2020 Q4 because the locations were found to be dry.
- MW-242-25, VB Ramp Sump and IFBA-GT-2A could not be sampled in 2020 Q4, as the locations were not accessible.
- Duplicate samples were not collected from MW325-15, MW-076-30 and VB Ramp sump due to miscommunication.
- The TAB foundation drain samples could not be collected because the drains were either dry or not accessible for sampling (due to safety reasons or the water level in the sump being higher than the sampling point). Continued efforts are being put forth by OPG with respect to improving the sampling methodology at these locations.
- Additional site perimeter samples were taken in Q1 2021.

3.2.2 Unit 1 to 4 Reactor Building Area Overview

The original source of tritium in groundwater in the Unit 1 area of PNGS was attributed to historical leakage from the moderator purification room sump and the Spent Resin Storage Tank (SRST) vault sumps. This prompted continued and regular groundwater monitoring in this area in order to track the movement of the plume.

In 2018, an adverse condition was identified in the Unit 1 area groundwater, which was attributed to a component leaking inside the moderator purification room. Corrective actions were undertaken in 2018 and have been successful in addressing the source.

In 2020, an emerging issue was identified in the Unit 1 area. A heavy water leak occurred and was identified in the Unit 1 Heat Transport purification room. After an investigation, it was determined that a leaking pipe was the cause of the issue and actions were taken to stop the leak immediately. Additional sampling of Unit 1 RB groundtubes and surrounding monitoring wells was performed to monitor the tritium impact to groundwater. Further details are provided below in Section 3.2.2.1.

In the Unit 4 area, tritium in groundwater is present due to historical leakage from the SRST vault sump, MK6. Corrective actions were previously undertaken in order to address the source and continue to be successful.

The 2020 groundwater sampling results are presented in Table A-1 (Appendix A) and Figure 2.

Key sampling locations are discussed in further detail below by specific area.

3.2.2.1 Unit 1 and 2 Area

The elevated tritium in groundwater in 2018 at the Unit 1 RB groundtube locations was due to a valve leaking inside the Unit 1 moderator purification room. The valve was subsequently repaired. Since then, the tritium concentrations have declined.

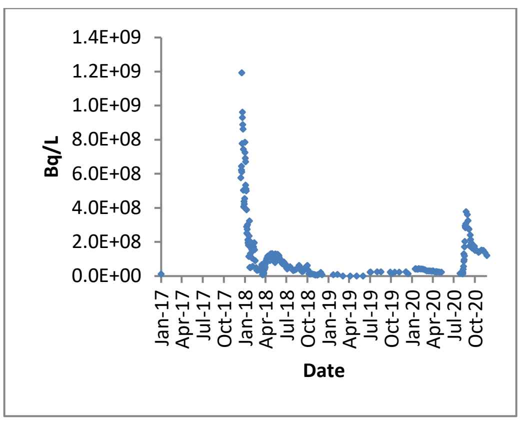
In 2020, an increase of tritium in groundwater was found at the Unit 1 RB groundtube locations, following an emerging issue which occurred in September 2020 when heavy water was discovered in the Heat Transport purification room. Groundtubes are rudimentary wells that were installed when the station was built and perform similarly to monitoring wells. Essentially, these sample locations are steel tubes that are perforated along its side-wall close to the bottom of the tube. The perforations allow groundwater to enter the tube. Around the RBs, the groundtubes terminate in the foundation drains encircling the RBs, within the shallow groundwater regime.

Following the identification of elevated tritium concentrations in the groundtube, the monitoring frequency at the groundtubes and surrounding monitoring wells was increased. After an investigation, it was determined that the contributing cause of the issue was a leaking pipe in the Heat Transport system, within the Heat Transport Purification Room. The water likely entered the groundwater through the foundation joints, resulting in an increase in tritium concentration in the Unit 1 RB groundtubes. The leak was isolated, investigated and corrective actions were taken to prevent recurrence of the event. Additional sampling of Unit 1 RB groundtubes and surrounding monitoring wells was performed to monitor the tritium impact to groundwater. Field inspections were also performed to identify potential leaks inside the Reactor Building, and actions were taken to initiate the required repairs. Since the repairs, a decrease in tritium concentrations in groundwater has been observed. Groundwater monitoring will continue in this area.

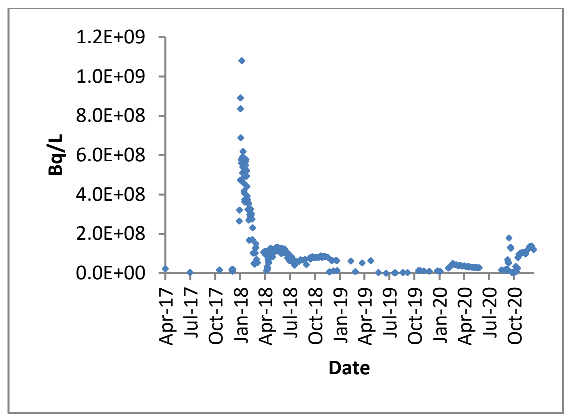
Graphs 1 to 4 illustrate the tritium concentrations over time for the Unit 1 RB foundation drainage groundtubes. In addition, data for the VBRS is also presented. As mentioned in Section 3.1, the VBRS acts as a hydraulic sink, collecting a portion of groundwater in the Unit 1 and 2 areas.

As can be seen on Figure 2, groundwater tritium concentrations in monitoring wells located between Unit 1 and the VB were elevated in 2020 due to the movement of groundwater towards the VBRS. There are also elevated tritium concentrations in the groundwater monitoring wells located to the northeast and west of the Unit 1 RB, as would be expected.

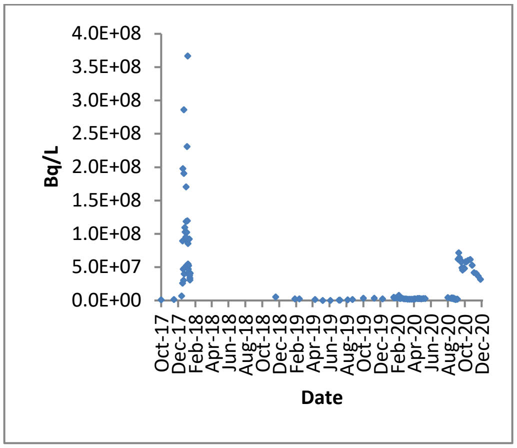
The results in this area will continue to be monitored.



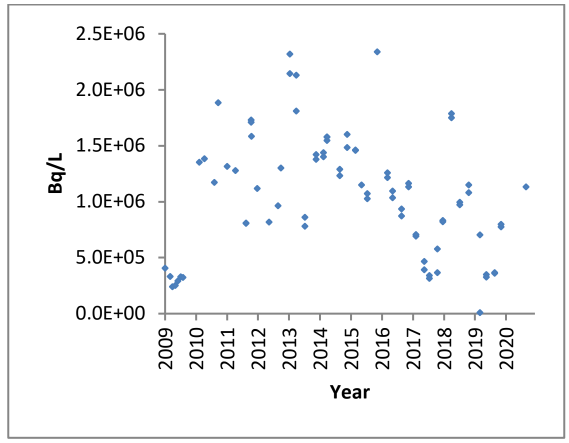
Graph 1: U1-RBFD-1 Tritium Data



Graph 2: U1-RBFD-2 Tritium Data



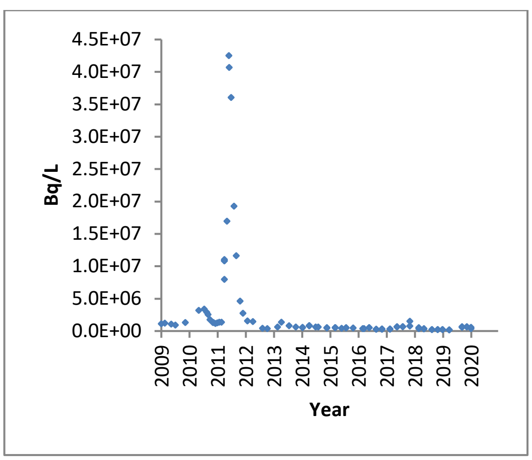
Graph 3: U1-RBFD-3 Tritium Data



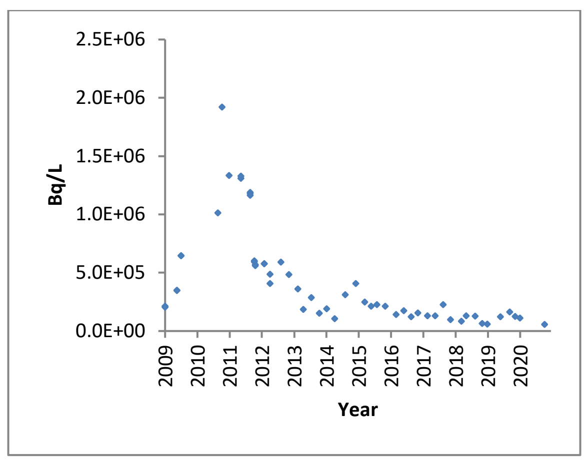
Graph 4: VBRS Tritium Data

3.2.2.2 Unit 3 and 4 Area

In the Unit 3 and 4 area, the results from the RB groundtubes, as well as from the monitoring wells located within the Reactor Auxiliary Bay (RAB), were stable. The concentration at MW-242-25 (which is adjacent to SRST vault sump, MK6) continues to remain low. This indicates that the repairs undertaken at MK6 in 2013 have been effective. The tritium concentration at downgradient monitoring well MW-243-29, also located in the RAB, did not show any significant changes. Graphs 5 and 6 illustrate the results for these monitoring wells.



Graph 5: MW-242-25 Tritium Data



Graph 6: MW-243-29 Tritium Data

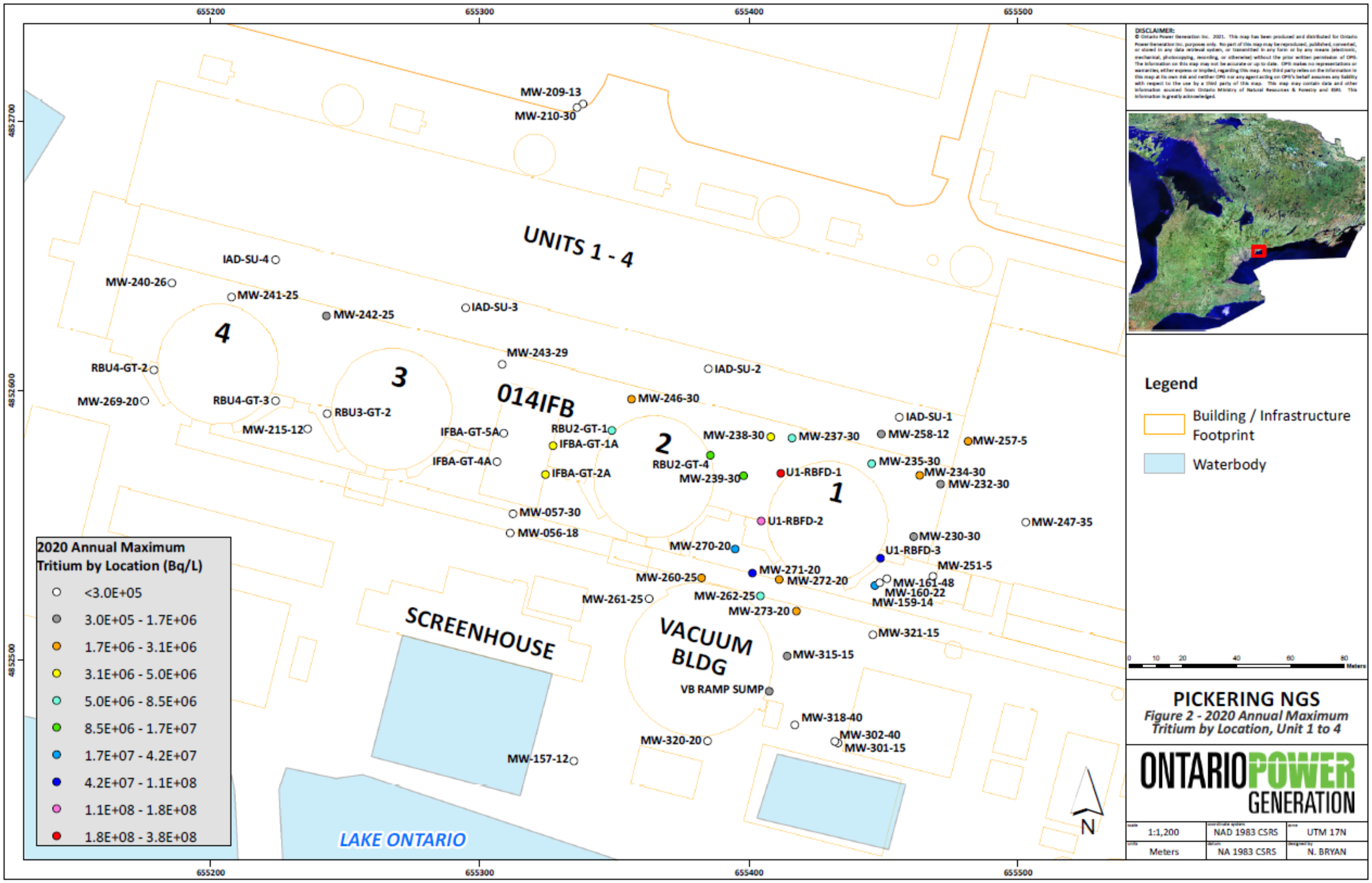


Figure 2 2020 Annual Maximum Tritium by Location, Unit 1 to 4

3.2.3 Unit 5 to 8 Reactor Building Area Overview

Historically, the sources of tritium in the Unit 5 to 8 area were attributed to releases from the RB foundation drainage sumps (designated as U5 MK26, U6 MK30, U7 MK36 and U8 MK42). These sumps collect groundwater from the foundation drainage rings that surround the RBs and pump the collected water to the Radioactive Liquid Waste Management System (RLWMS). The back-flow of tritiated water is prevented by a non-return valve on the sump discharge line; however, it was found that the valves were not operating as designed, due to sludge build-up. This allowed tritiated water to leak back into the sumps, back up into the RB foundation drains and infiltrate the surrounding groundwater environment. Since this discovery, a preventative maintenance program has been in place to proactively address the issues identified for the RB foundation drainage sumps and the non-return valves.

In 2016, an adverse condition was identified in the Unit 5 area due to degraded construction joints in the Unit 5 moderator room floor. A thorough investigation was undertaken, followed by repairs, which have proven to be successful. Similar repairs were also implemented at Unit 6.

In 2019, an emerging issue was identified in the Unit 8 area. It was determined that a valve in the RAB was the likely contributing factor. The valve was repaired and groundwater monitoring continues in the Unit 8 area. Further details are provided below in Section 3.2.3.4.

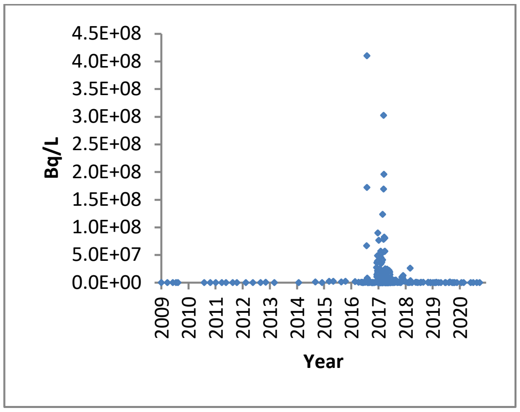
In 2020, an emerging issue was identified in the Unit 6 area in Q4. Following an investigation, it was determined that there was a valve leaking in the Unit 6 Moderator Purification System. Actions were taken to stop the leak and the repair is now complete. Groundwater monitoring will continue in the Unit 6 area.

The 2020 groundwater sampling results are presented in Table A-2 (Appendix A) and Figure 3. The tritium concentrations in Figure 3 are represented using coloured circles.

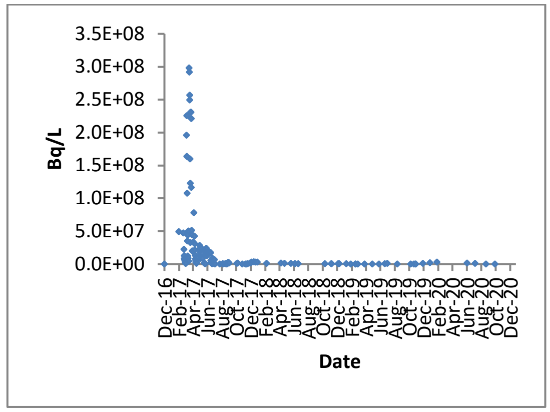
Key sampling locations are discussed in further detail below by specific area.

3.2.3.1 Unit 5 Area

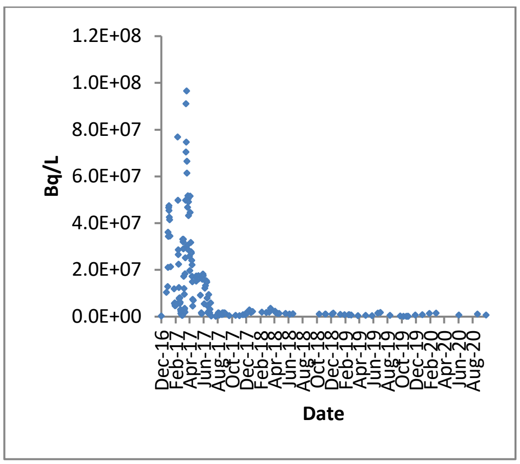
The samples collected from the Unit 5 RB area in 2020 indicate that tritium concentrations in groundwater have declined following the repairs completed on the moderator room floor construction joints in 2017 and remain stable. Graphs 7 to 12 present the data from the Unit 5 RB foundation drainage groundtubes (RBU5-GT-1 to RBU5-GT-4), the U5 MK26 sump and monitoring well MW-267-17. Groundwater monitoring will continue in this area to track the movement of tritium.



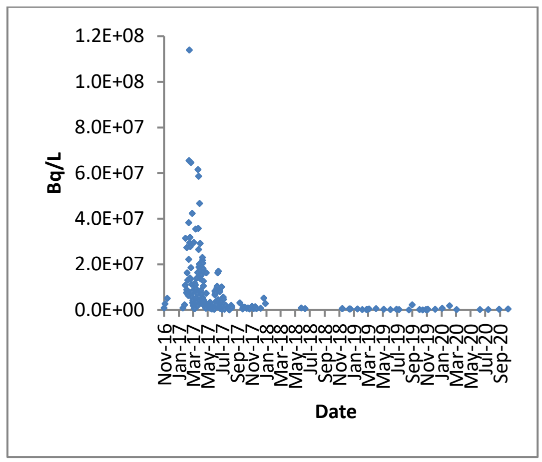
Graph 7: RBU5-GT-1 Tritium Data



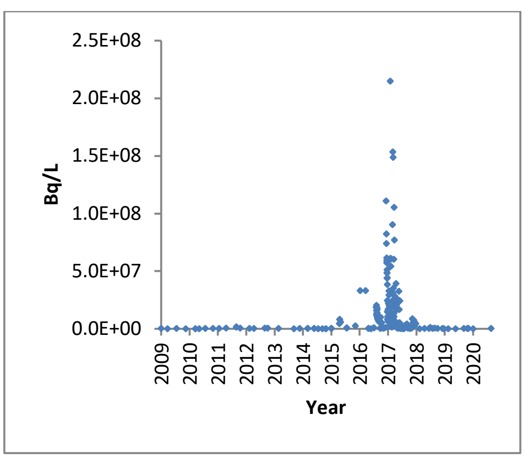
Graph 8: RBU5-GT-2 Tritium Data



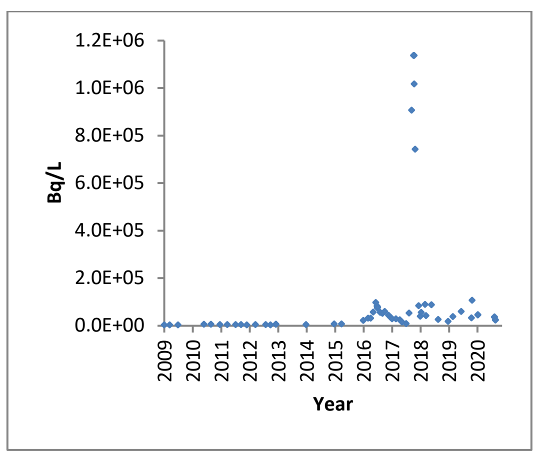
Graph 9: RBU5-GT-3 Tritium Data



Graph 10: RBU5-GT-4 Tritium Data



Graph 11: U5 MK26 Tritium Data

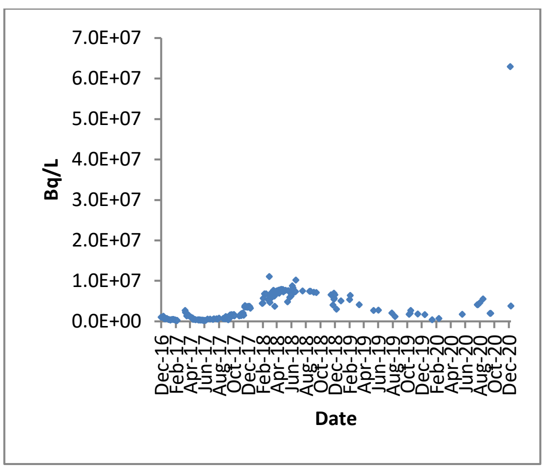


Graph 12: MW-267-17 Tritium Data

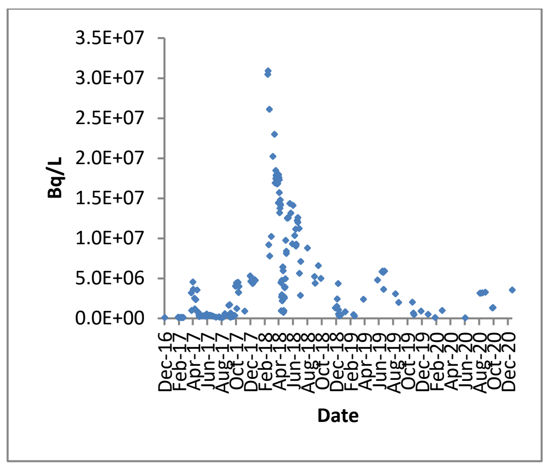
3.2.3.2 Unit 6 Area

In the Unit 6 area, elevated concentrations were identified in 2018 and repairs of construction joints were undertaken based on the operating experience at Unit 5, which proved to be successful.

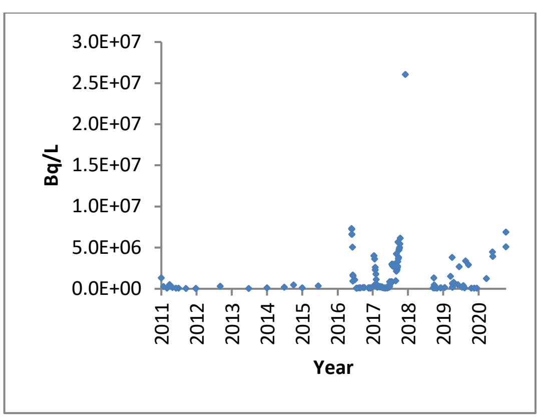
In Q4 2020, an emerging issue occurred in Unit 6. After an investigation, it was identified that a leak occurred in a valve in the Unit 6 Moderator Purification System. Actions were undertaken to stop the leak immediately, and the required repair was completed. An increase in groundwater tritium concentrations was observed in the Unit 6 RB foundation drainage groundtubes and Unit 6 MK30 sump. An elevated tritium concentration was noted in RUBU6-GT-2 in December 2020, and a follow up sample indicated the concentration decreased. As a follow-up, the monitoring frequency at the groundtubes and surrounding monitoring wells of Unit 6 was increased. Graphs 13 to 17 present the data from the Unit 6 RB foundation drainage groundtubes (RBU6-GT-2 to RBU6-GT-4), the U6 MK30 sump and monitoring well MW-266-19. This area will continue to be monitored.



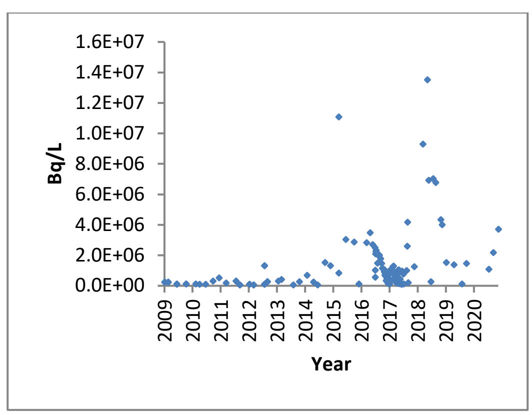
Graph 13: RBU6-GT-2 Tritium Data



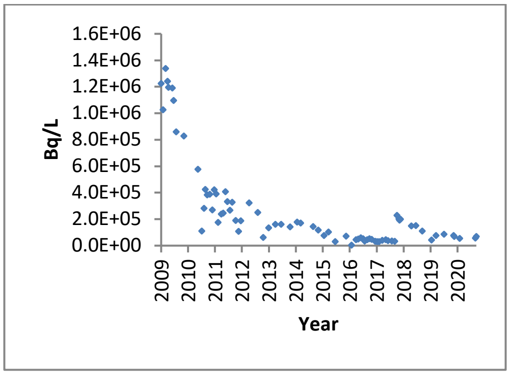
Graph 14: RBU6-GT-3 Tritium Data



Graph 15: RBU6-GT-4 Tritium Data



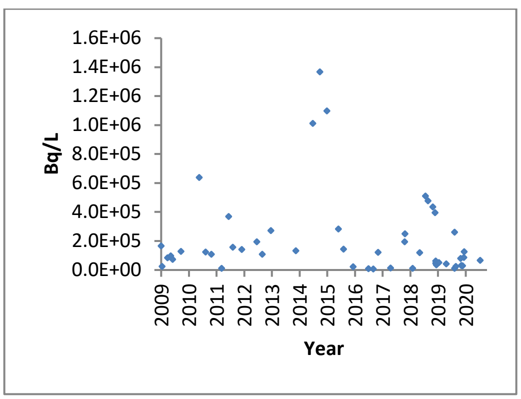
Graph 16: U6 MK30 Tritium Data



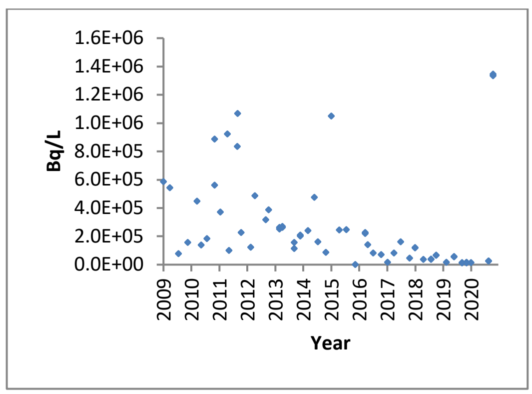
Graph 17: MW-266-19 Tritium Data

3.2.3.3 Unit 7 Area

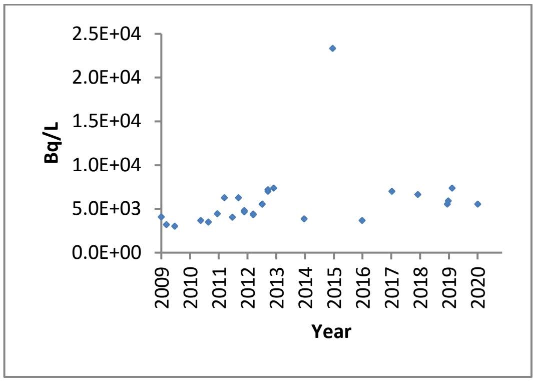
In 2020, an increase in groundwater tritium concentration was noted in U7 MK36 in Q4. The concentration has subsequently decreased, and no emerging issues identified. Fluctuation in tritium concentration in this area is expected due to tritium movement, and the area will continue to be monitored. Graphs 18 to 20 illustrate the data for RBU7-GT-1, U7 MK36 and MW-265-12.



Graph 18: RBU7-GT-1 Tritium Data



Graph 19: U7 MK36 Tritium Data



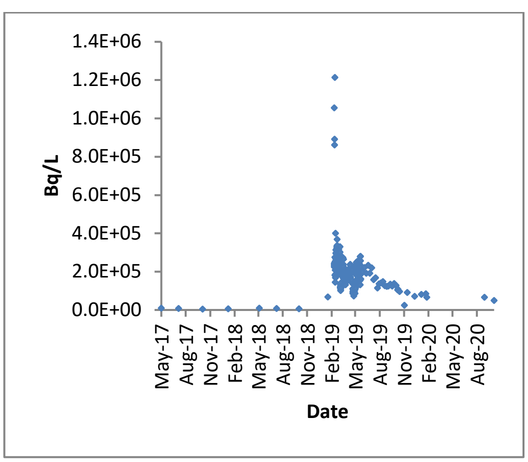
Graph 20: MW-265-12 Tritium Data

3.2.3.4 Unit 8 Area

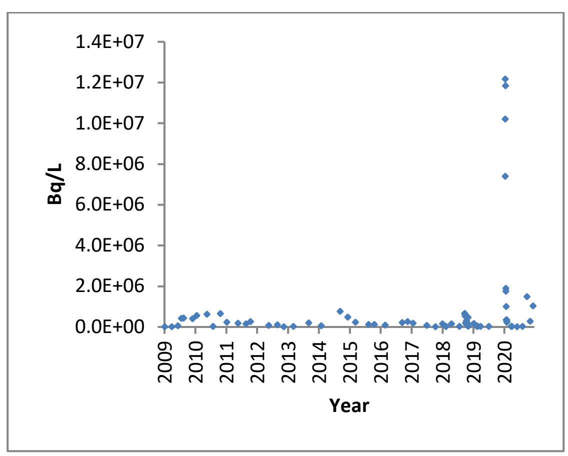
In 2020, tritium concentrations in the Unit 8 TAB IAD sump were monitored as a follow up to mitigation activities undertaken in the previous year to address the valve issue in the RAB, as shown in Graph 21. Groundwater flows north from underneath the RAB towards the TAB IAD foundation drainage and sumps. The tritium concentrations at IAD-SU-8 have continued to trend downwards in 2020.

In 2020, an increase in groundwater tritium concentration was noted in U8 groundtubes in Q1 and Q4, and U8 MK42 in Q4. The concentrations appeared to decrease subsequently in the U8 groundtubes. No emerging issues were identified. This area will continue to be monitored.

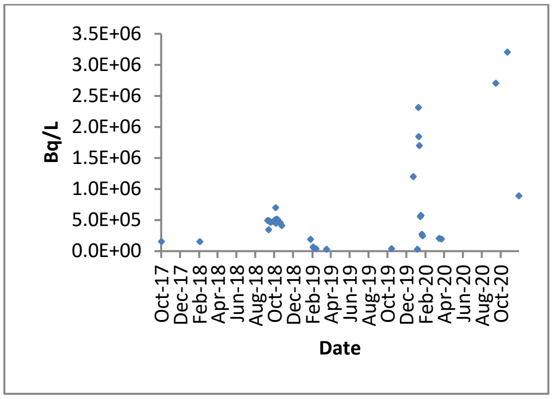
Graphs 22 to 27 illustrate the tritium data for the Unit 8 RB foundation drainage groundtubes, U8 MK42 and monitoring well MW-264-10.



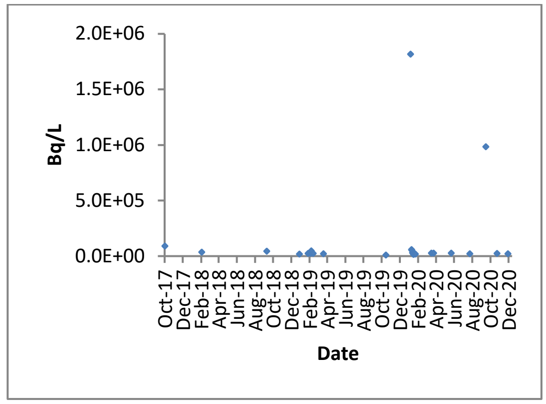
Graph 21: IAD-SU-8 Tritium Data



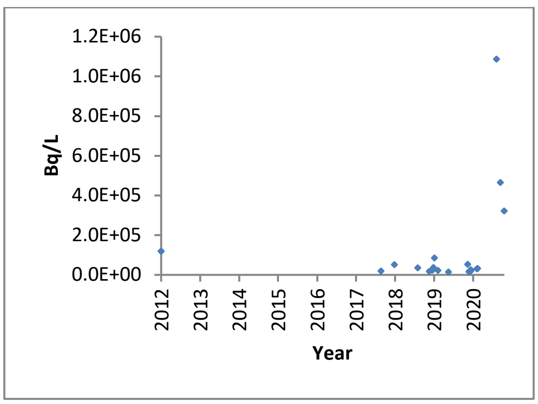
Graph 22: RBU8-GT-1 Tritium Data



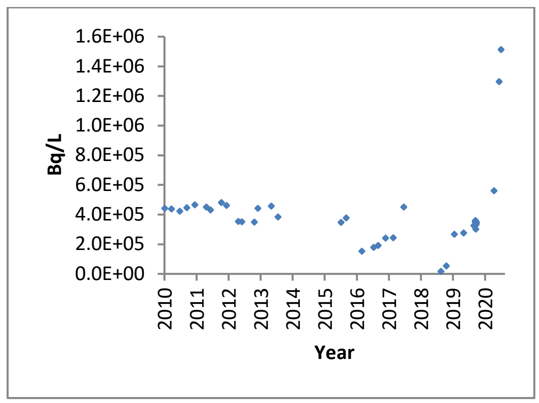
Graph 23: RBU8-GT-2 Tritium Data



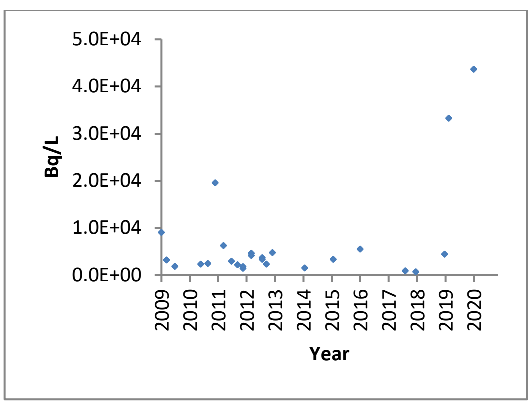
Graph 24: RBU8-GT-3 Tritium Data



Graph 25: RBU8-GT-4 Tritium Data



Graph 26: U8 MK42 Tritium Data



Graph 27: MW-264-10 Tritium Data

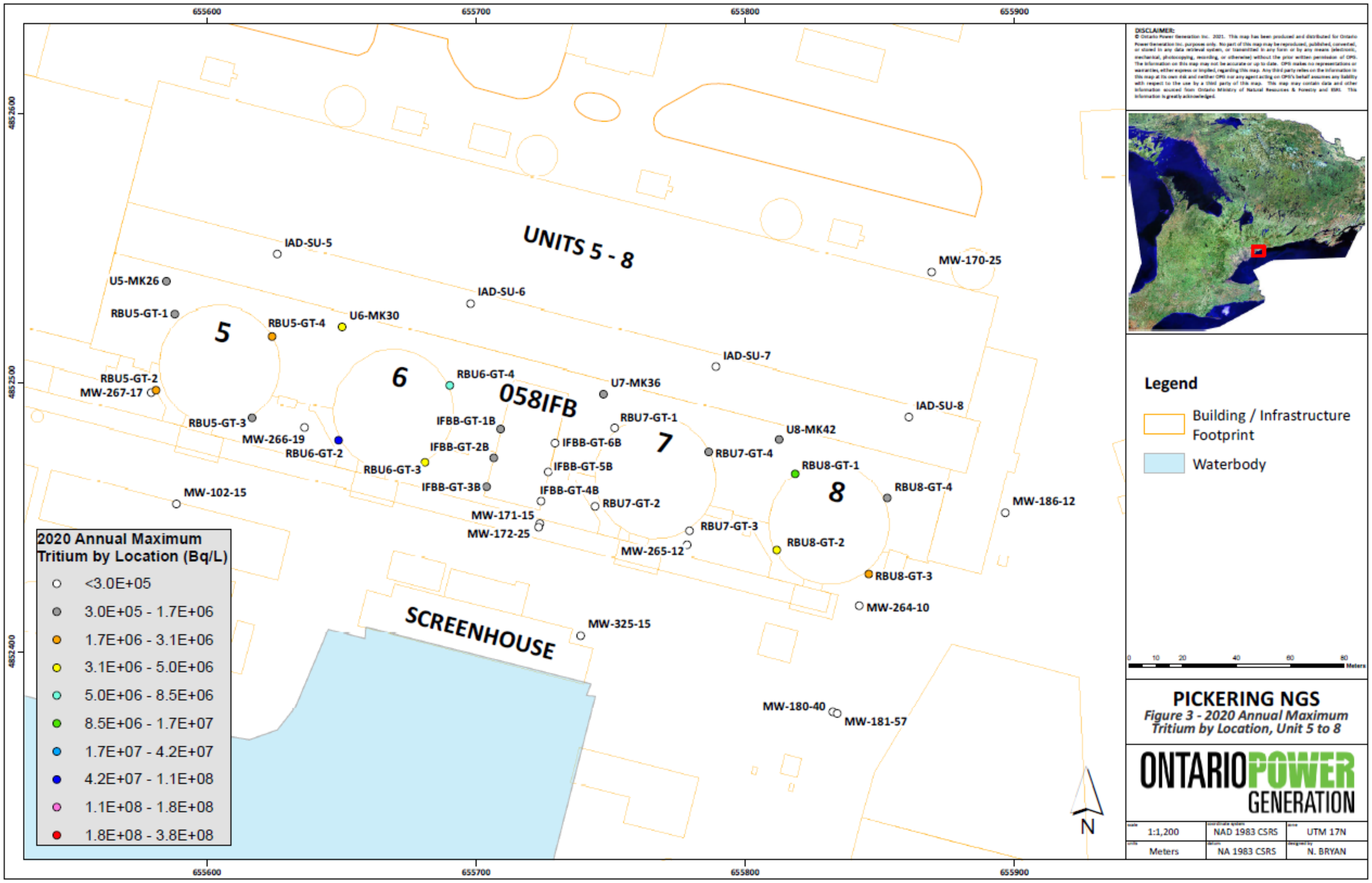


Figure 3 2020 Annual Maximum Tritium by Location, Unit 5 to 8

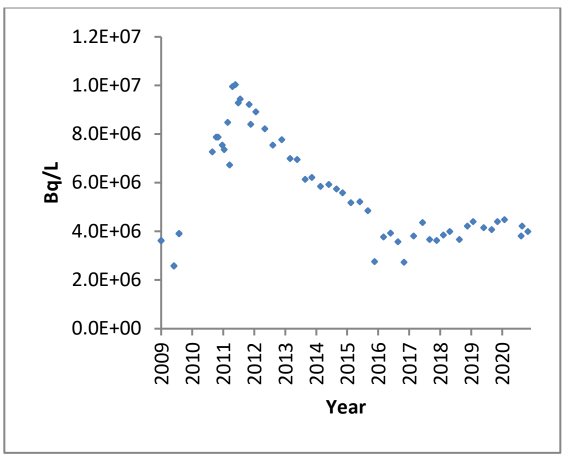
3.2.4 Irradiated Fuel Bay Areas

3.2.4.1 IFB-A

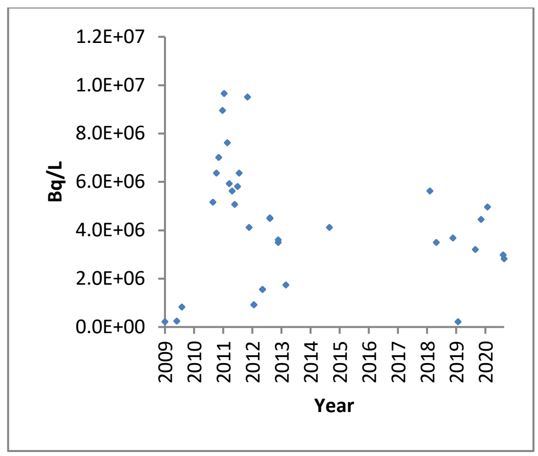
The groundwater results collected from sampling locations in the Irradiated Fuel Bay area located between Units 2 and 3 (IFB-A) are described below.

The eastern groundtubes (IFBA-GT-1A and IFB-GT-2A) showed higher tritium concentrations than those to the west (IFBA-GT-4A and IFB-GT-5A). This is expected given that the western edge of the tritium plume in the Unit 1 area extends towards the IFB-A. As mentioned previously, groundwater in the protected area eventually flows north towards the low-lying TAB sumps.

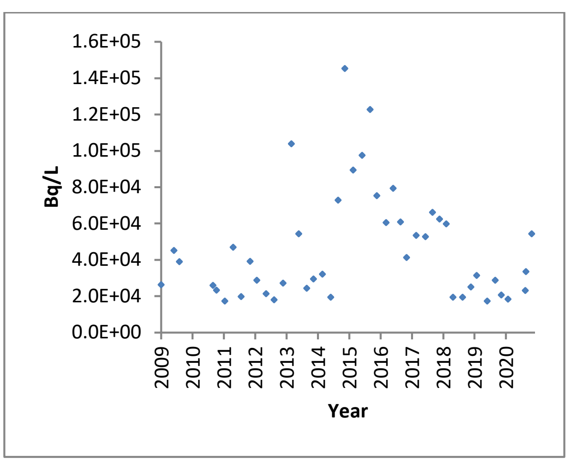
Tritium concentrations over time for the IFB-A groundtubes and monitoring wells are presented in Graphs 28 to 33. The results are also presented in Table A-3 (Appendix A) and Figure 2.



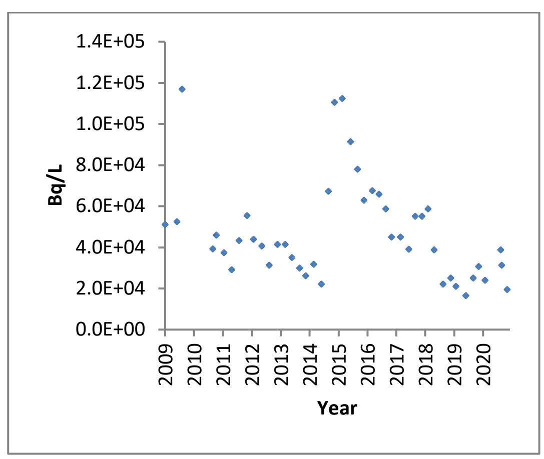
Graph 28: IFBA-GT-1A Tritium Data



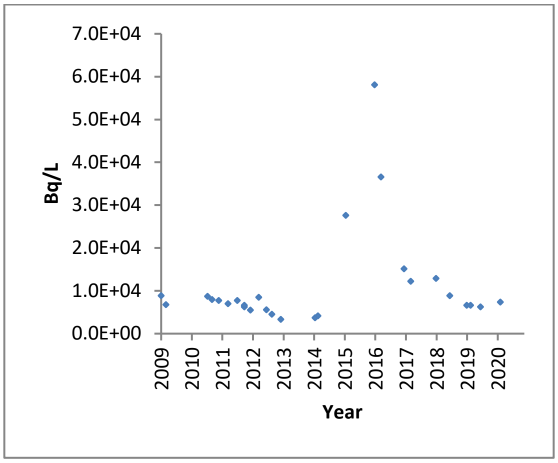
Graph 29: IFBA-GT-2A Tritium Data



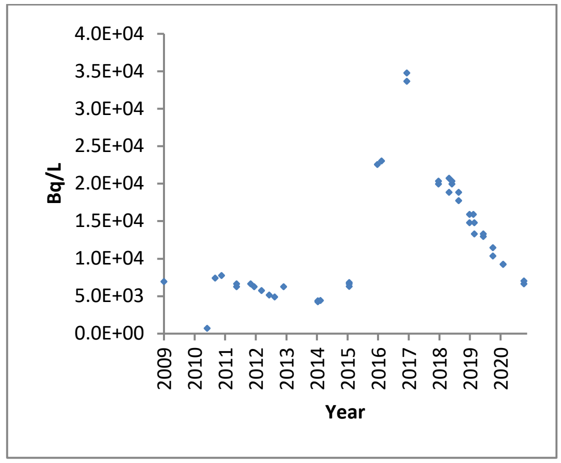
Graph 30: IFBA-GT-4A Tritium Data



Graph 31: IFBA-GT-5A Tritium Data



Graph 32: MW-056-18 Tritium Data



Graph 33: MW-057-30 Tritium Data

3.2.4.2 IFB-B

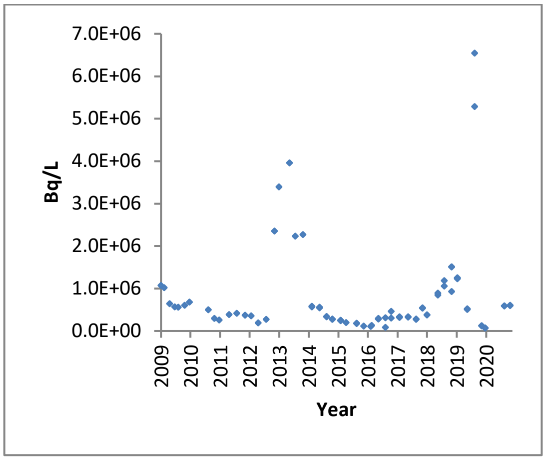
The groundwater results collected from sampling locations in the Irradiated Fuel Bay area located between Units 6 and 7 (IFB-B) are described below.

In 2020, tritium concentrations in the western groundtubes (IFBB-GT-1B, IFBB-GT-2B and IFBB-GT-3B) decreased from 2018. Fluctuations at these groundtubes are expected as the tritium in groundwater in the Unit 5 area moves slowly in a north-easterly direction towards the TAB IAD sumps.

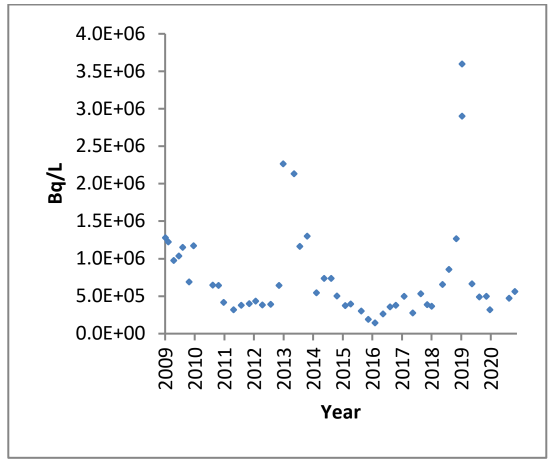
There were no significant changes in tritium concentrations in eastern groundtubes IFBB-GT-5B and IFBB-GT-6B in 2020. Eastern groundtube IFBB-GT-4B showed an increase in 2019 Q1. It was confirmed that there were no issues with the operation of the IFB-B. The tritium concentration in IFBB-GT-4B continued to decrease in 2020.

The two upgradient monitoring wells (MW-171-15 and MW-172-25) continued to show low tritium concentrations.

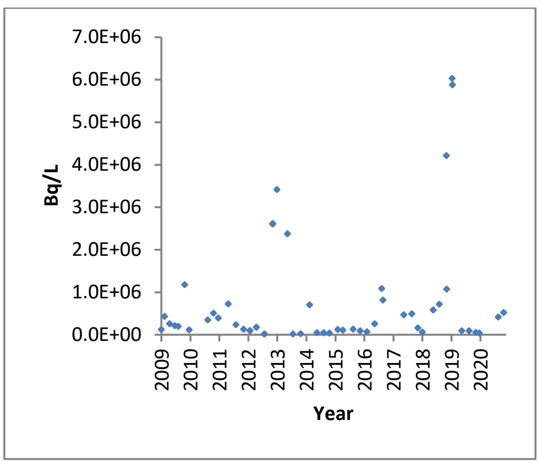
Tritium concentrations over time for the IFB-B groundtubes and monitoring wells are presented in Graphs 34 to 41. The results are also presented in Table A-3 (Appendix A) and Figure 3.



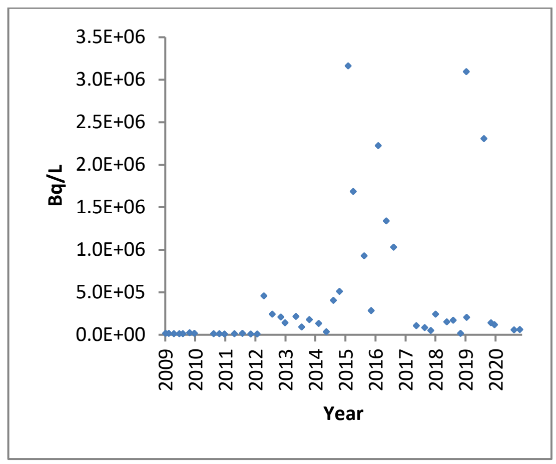
Graph 34: IFBB-GT-1B Tritium Data



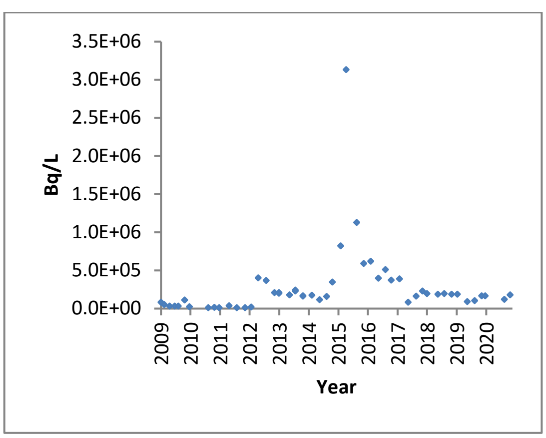
Graph 35: IFBB-GT-2B Tritium Data



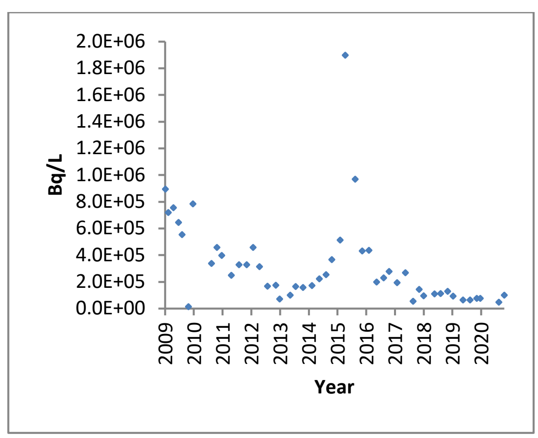
Graph 36: IFBB-GT-3B Tritium Data



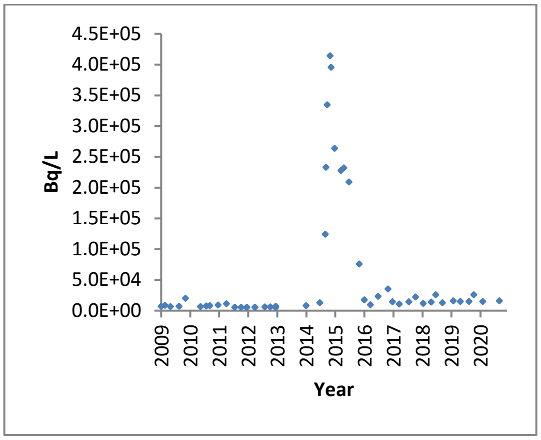
Graph 37: IFBB-GT-4B Tritium Data



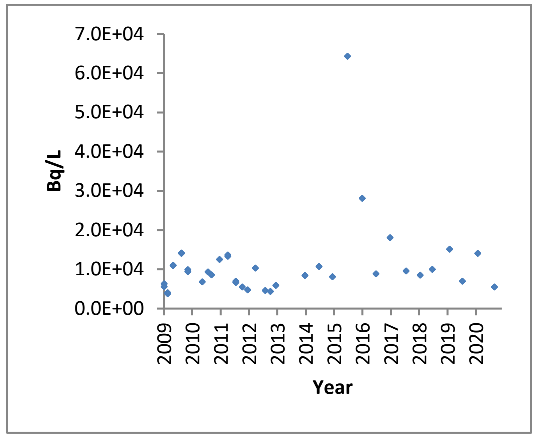
Graph 38: IFBB-GT-5B Tritium Data



Graph 39: IFBB-GT-6B Tritium Data



Graph 40: MW-171-15 Tritium Data



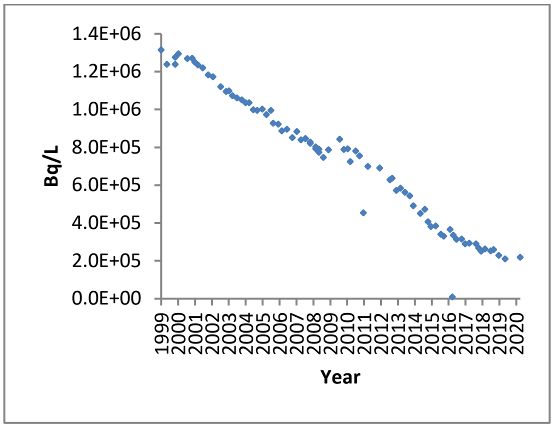
Graph 41: MW-172-25 Tritium Data

3.2.5 Upgrading Plant Pickering Area

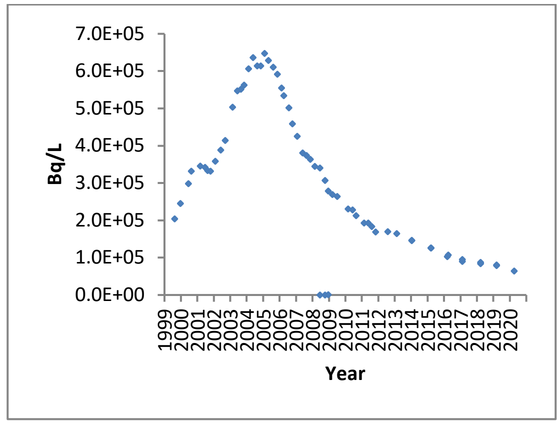
The groundwater results from the UPP area monitoring wells indicate that there is no new source of tritium in groundwater in this area. The legacy tritium in groundwater present in this area is due to past work practices that resulted in discharges of tritiated water to the ground. These practices were discontinued in 1997.

Tritium concentrations at the legacy source area, MW-090-20, continue to decrease as would be expected, given that there is no new source of tritium. In the downgradient monitoring well, MW-076-20, tritium concentrations also continue to decline after a peak seen in 2005. A portion of the outer edge of the UPP tritium plume is directed westwards towards the warehouse due to a preferential groundwater pathway created by a subsurface utility pipe. Monitoring well MW-096-20, located by the warehouse, had shown a generally increasing trend until about 2011; however, recent concentrations have stabilized.

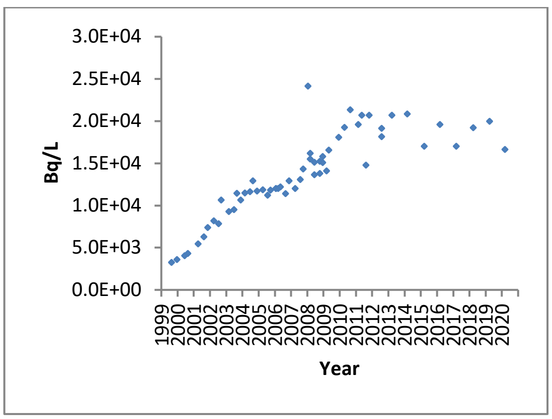
Tritium concentrations over time for the above-mentioned monitoring wells are presented in Graphs 42 to 44. The results for the locations sampled in the UPP area are presented in Table A-4 (Appendix A) and Figure 4.



Graph 42: MW-090-20 Tritium Data



Graph 43: MW-076-20 Tritium Data



Graph 44: MW-096-20 Tritium Data

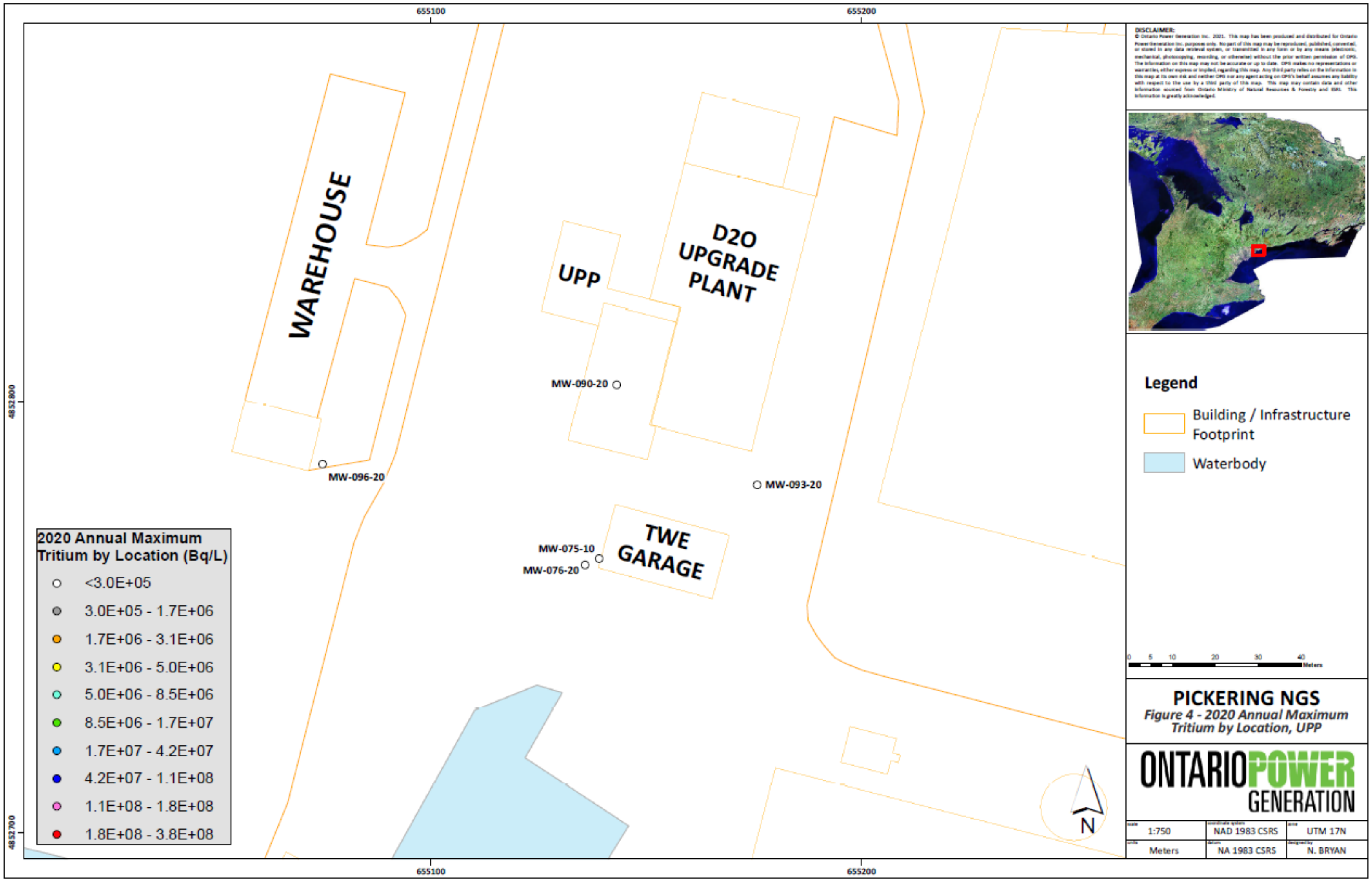


Figure 4 2020 Annual Maximum Tritium by Location, UPP

3.2.6 Emergency Power Generator Area

In 2020, no groundwater samples were collected for conventional parameters.

3.2.7 Standby Generator Areas

In 2020, groundwater wells in the PNGS SG areas were sampled to confirm whether the biodegradation of residual subsurface fuel oil is occurring. A total of 24 groundwater monitoring wells were monitored for groundwater/fuel oil product levels and sampled for Benzene / Toluene / Ethylbenzene / Xylene (BTEX) and Petroleum Hydrocarbon (PHCs) in 2020.

A review of the 2020 data indicates that the natural attenuation of residual fuel oil in groundwater continues to occur at these areas.

The monitoring and sampling frequency for these areas will take place on a biennial basis, with the next scheduled sampling event planned for 2022.

3.3 Objective 3 Results

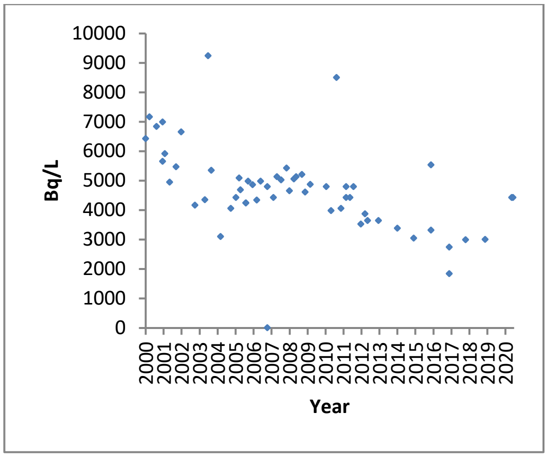
In 2020, due to the COVID-19 pandemic, most of the groundwater samples from the site perimeter monitoring well locations could not be collected as planned, except for MW-164-13 and MW-226-22 as shown in Table A-6 (Appendix A), and the annual maximum tritium concentrations presented in Figure 5. Additional groundwater samples from site perimeter monitoring well locations were taken in Q1 2021 as due diligence, and the results are presented in Table 3-1 below and Graphs 45 to 72.

Table 3-1 2021 Tritium Concentration Results at Site Perimeter Monitoring Locations

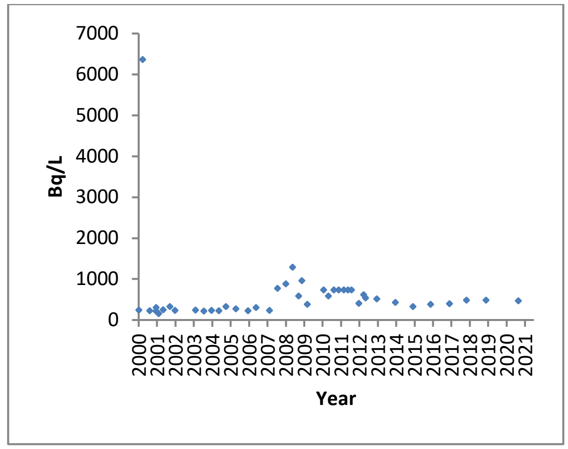
Sample Location Name (Site Perimeter)	Q1 2021 Tritium Results (Bq/L)
MW-164-13	3,337
MW-165-24	474
MW-176-23	33
MW-177-35	33
MW-183-10	1,021
MW-184-27	81
MW-185-39	26
MW-192-18	374
MW-193-37	259
MW-194-57	19
MW-195-73	19
MW-198-20	181
MW-199-38	19
MW-200-22	326
MW-201-39	19
MW-204-24	126
MW-205-35	148
MW-206-65	19
MW-207-87	19
MW-216-15	252
MW-217-32	19
MW-222-10	688
MW-223-32	714
MW-224-42	692
MW-225-12	1,154
MW-226-22	3,315
MW-227-40	19
MW-228-57	19

As can be seen, tritium concentrations at the perimeter of PNGS remained low. A wet air deposition investigation showed that the upper tritium concentration found in rainwater sampled on-site is approximately 3.70×10^4 Bq/L (1.00 μCi/kg).

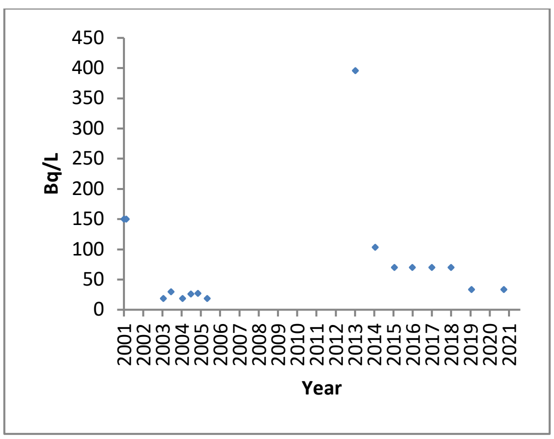
As part of the annual OPG PNGS Environmental Monitoring Program (EMP), municipal drinking water samples are collected from the surrounding Water Supply Plants (WSPs). In 2020, the data from this sampling demonstrated that the annual average tritium concentration at each WSP was well below the Ontario Drinking Water Quality Standard (ODWQS) for tritium of 7,000 Bq/L. This further supports that there were no indications of adverse off-site impacts from PNGS groundwater.



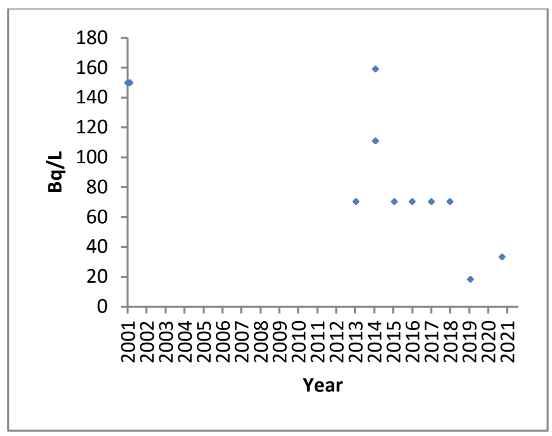
Graph 45: MW-164-13 Tritium Data



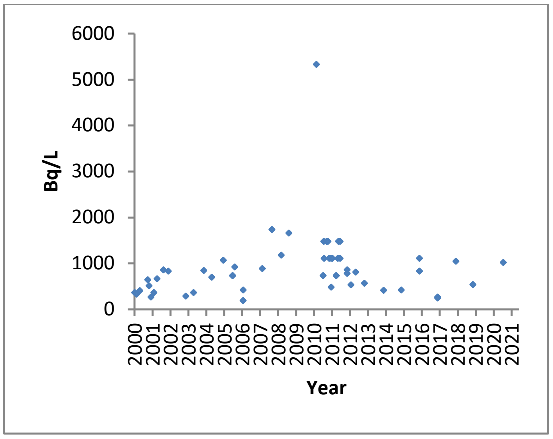
Graph 46: MW-165-24 Tritium Data



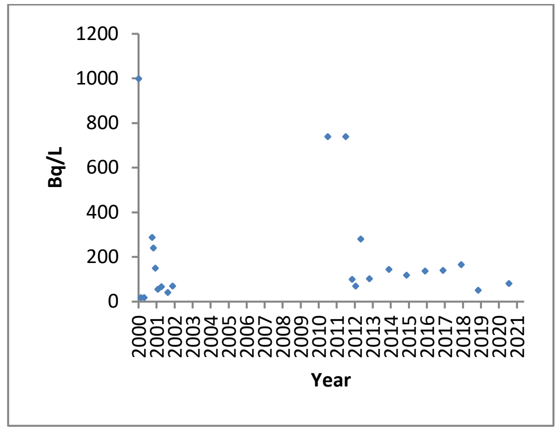
Graph 47: MW-176-23 Tritium Data



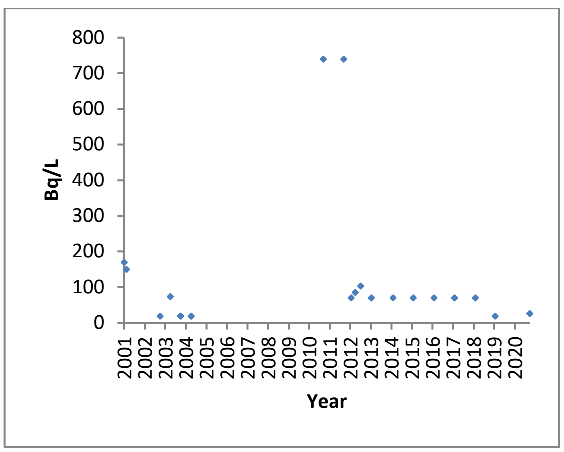
Graph 48: MW-177-35 Tritium Data



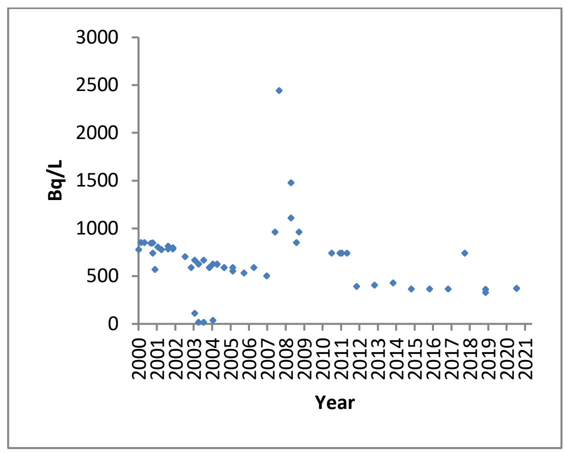
Graph 49: MW-183-10 Tritium Data



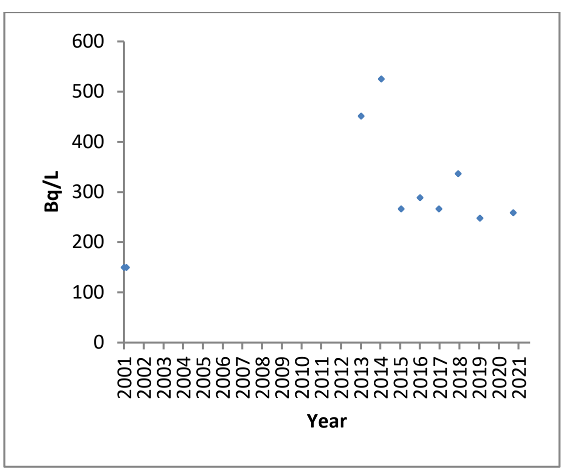
Graph 50: MW-184-27 Tritium Data



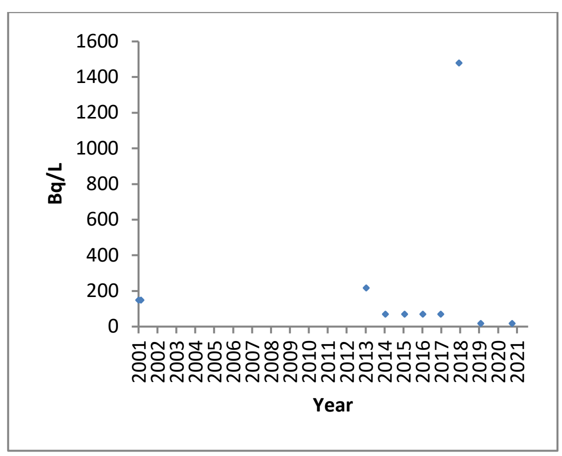
Graph 51: MW-185-39 Tritium Data



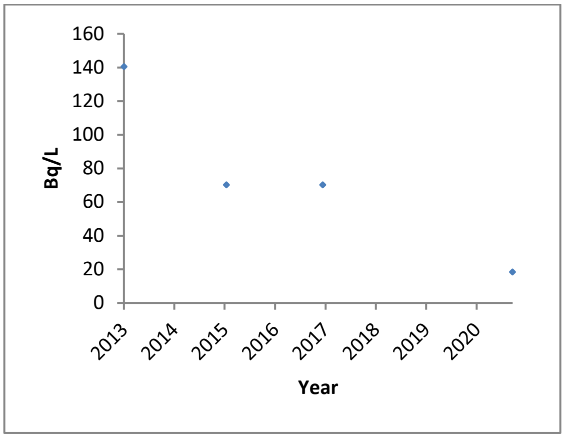
Graph 52: MW-192-18 Tritium Data



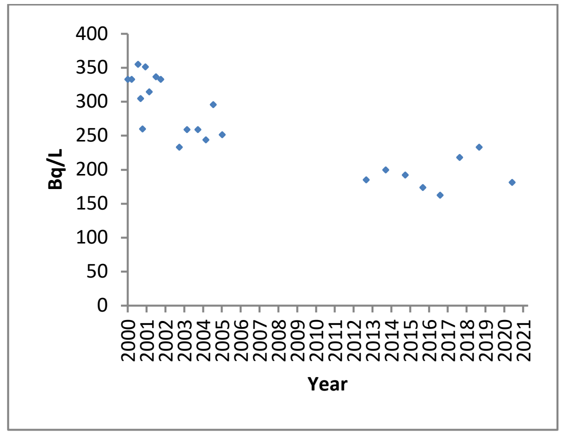
Graph 53: MW-193-37 Tritium Data



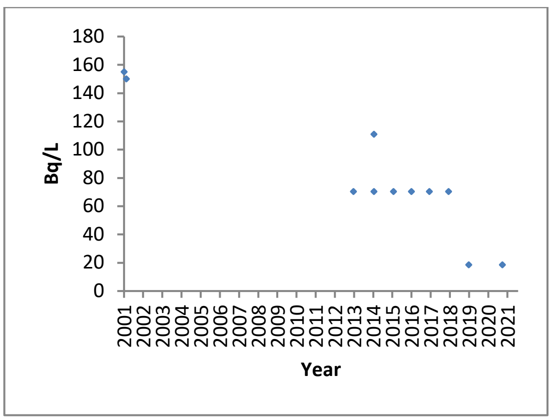
Graph 54: MW-194-57 Tritium Data



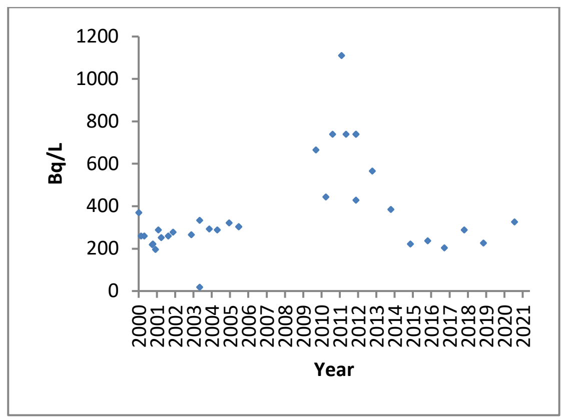
Graph 55: MW-195-73 Tritium Data



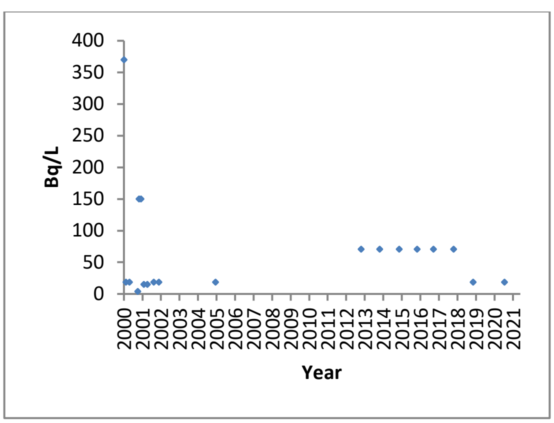
Graph 56: MW-198-20 Tritium Data



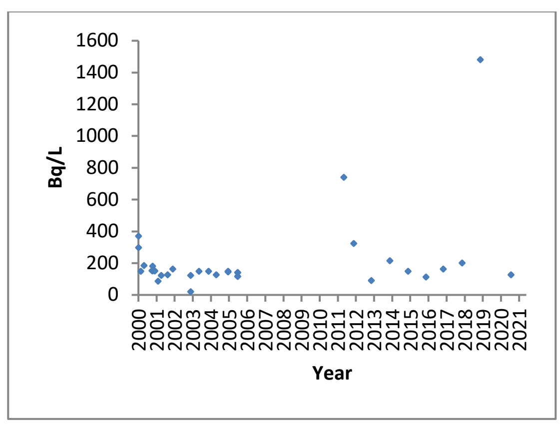
Graph 57: MW-199-38 Tritium Data



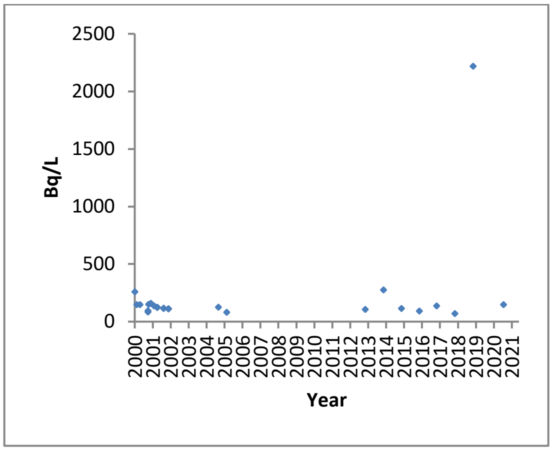
Graph 58: MW-200-22 Tritium Data



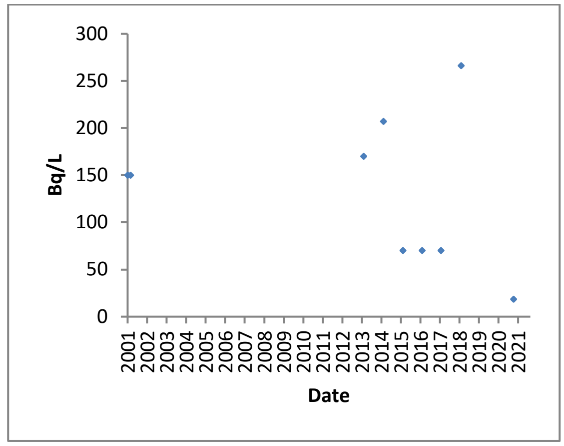
Graph 59: MW-201-39 Tritium Data



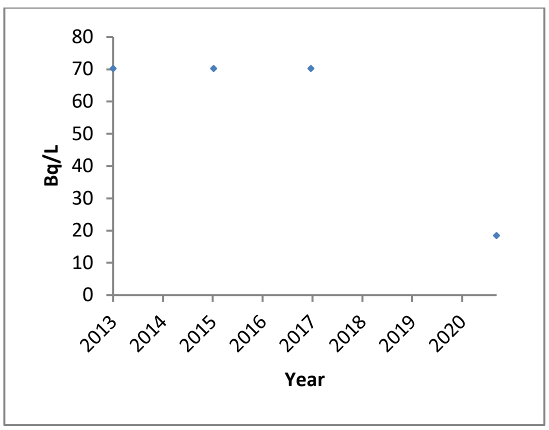
Graph 60: MW-204-24 Tritium Data



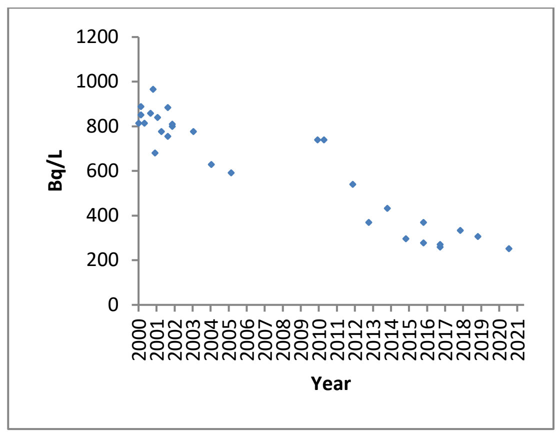
Graph 61: MW-205-35 Tritium Data



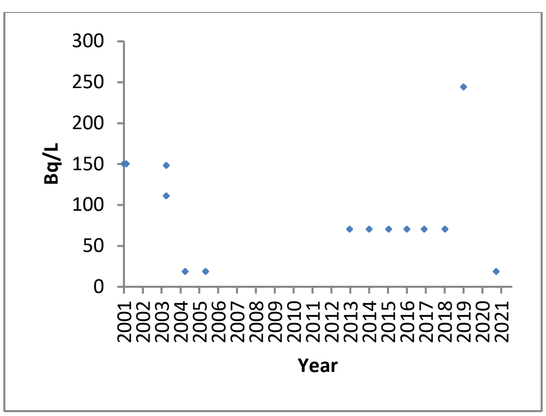
Graph 62: MW-206-65 Tritium Data



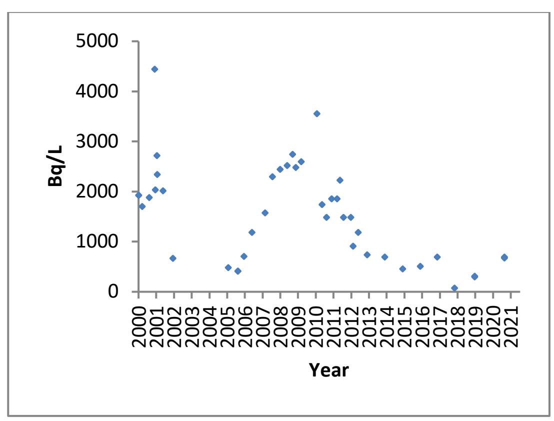
Graph 63: MW-207-87 Tritium Data



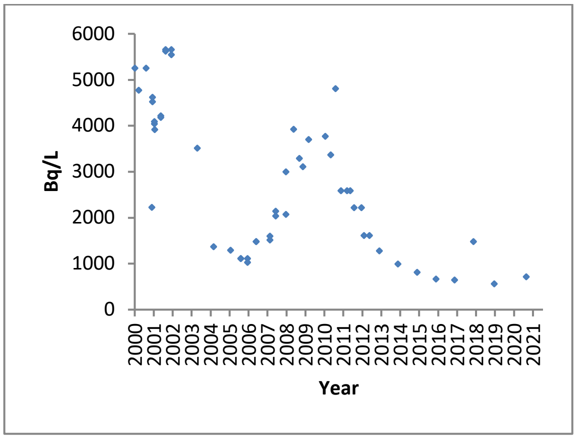
Graph 64: MW-216-15 Tritium Data



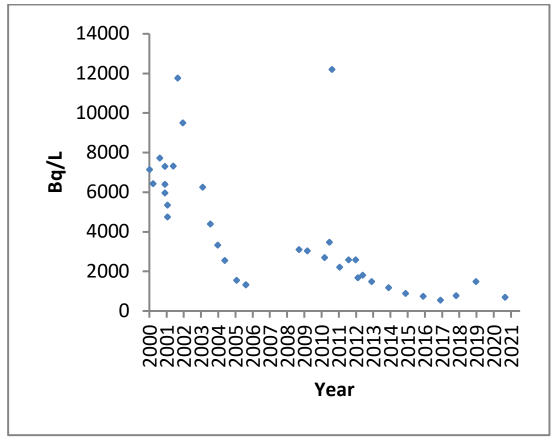
Graph 65: MW-217-32 Tritium Data



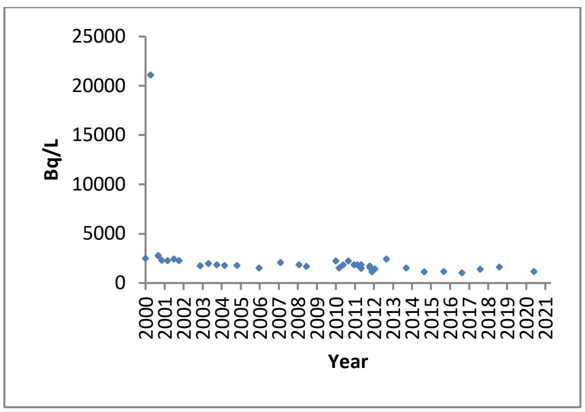
Graph 66: MW-222-10 Tritium Data



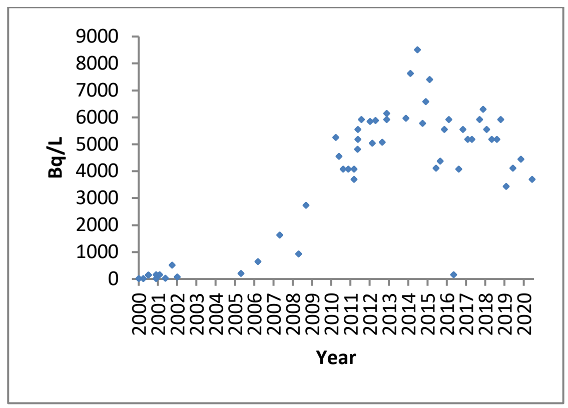
Graph 67: MW-223-32 Tritium Data



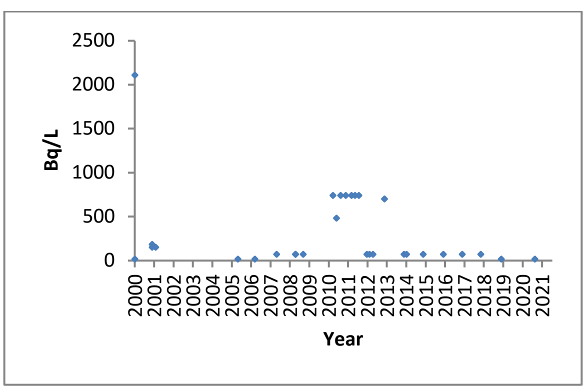
Graph 68: MW-224-42 Tritium Data



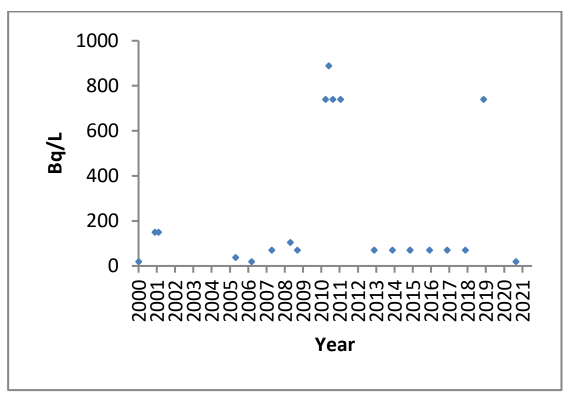
Graph 69: MW-225-12 Tritium Data



Graph 70: MW-226-22 Tritium Data



Graph 71: MW-227-40 Tritium Data



Graph 72: MW-228-57 Tritium Data

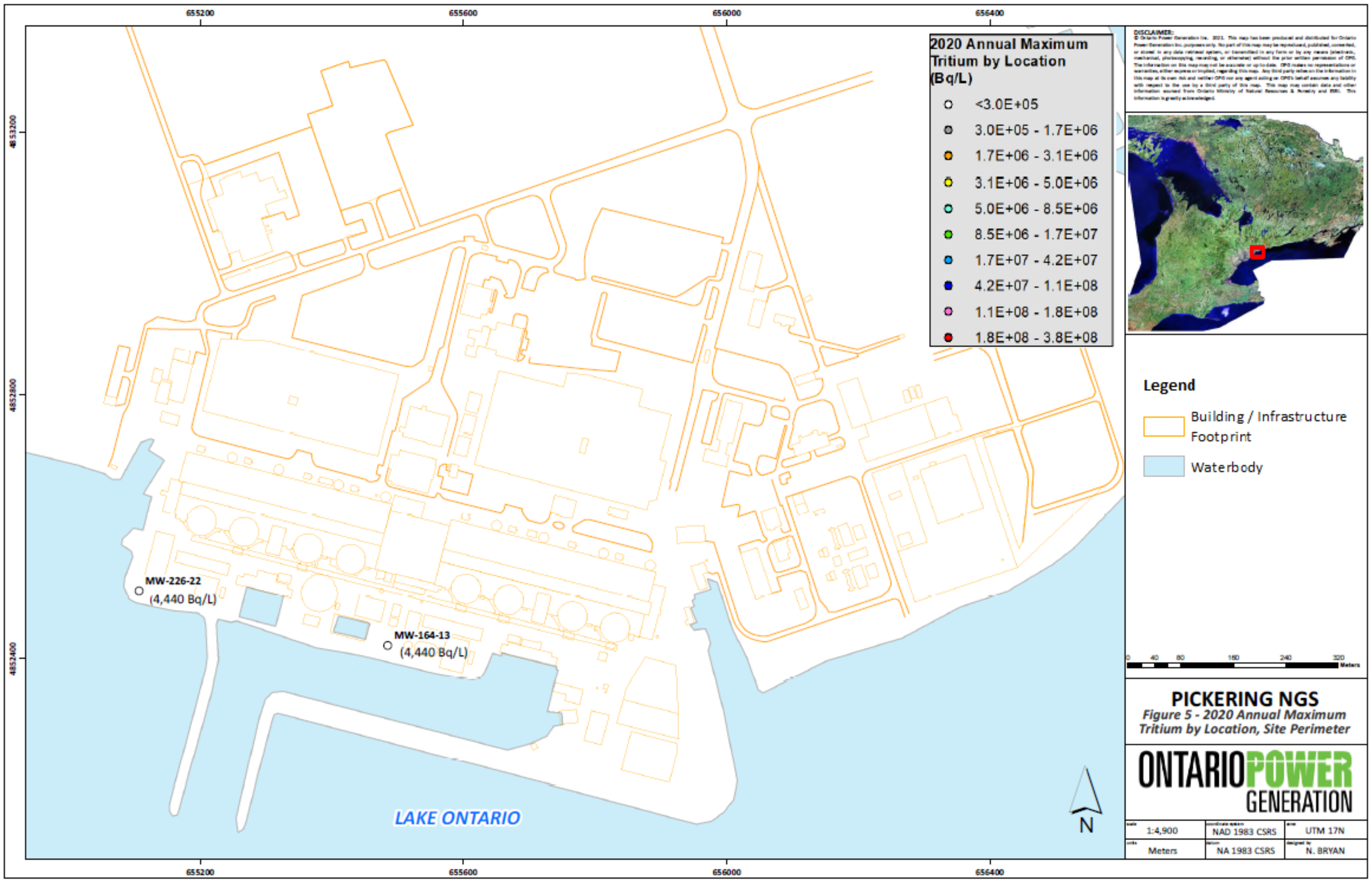


Figure 5 2020 Annual Maximum Tritium by Location, Site Perimeter

4.0 2020 PROGRAM QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance and Quality Control (QA/QC) measures for the groundwater monitoring program encompass all activities in field sample collection, laboratory analysis and laboratory quality control. The objective is to provide confidence in the interpretation of the PNGS groundwater monitoring data through a systematic and documented process.

4.1 Quality Assurance Programs for Laboratories

In 2020, as indicated in Section 3.2.1, conventional samples were not collected. Future samples for conventional analysis will be collected as required by the SAP.

The PNGS Chemistry Lab performs laboratory activities according to a documented quality assurance program.

4.2 Quality Control Results

Duplicates, field blanks and trip blanks were collected at a prescribed frequency to measure sampling and analytical performance.

In 2020, 17 field duplicate samples were collected. The results and calculated Relative Percentage Difference (RPD), to understand the sampling precision, are presented in Table A-9 (Appendix A). The majority of sample pairs (16 out of 17) showed a RPD below 20 percent. One pair of sample had a RPD of 43%. Given that 94% of the duplicate samples were within acceptable variation, the field technique and the laboratory's analytical methods employed were determined to be reproducible and reliable.

5.0 SUPPLEMENTARY STUDIES AND AUDITS

There were no supplementary studies initiated or completed in 2020.

6.0 CSA N288.7 UPDATE

OPG's Pickering site (including PNGS and Pickering Waste Management Facility) is in compliance with CSA N288.7-15, "Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills" as of December 31, 2020. OPG informed the Canadian Nuclear Safety Commission (CNSC) of this compliance (P-CORR-00531-22538).

7.0 NOMENCLATURE OF SAMPLING LOCATIONS

Sampling Location Type	Identifier	Explanation of Nomenclature
Monitoring Well	MW-*XXX*-*YY*	*XXX* represents a unique identifier *YY* represents the depth of the monitoring well in feet
Reactor Building Foundation Drainage Groundtube	RBU*X*-GT-*Y*	*X* represents the unit associated with the groundtube *Y* represents the position (1 is northwest, 2 is southwest, 3 is southeast, 4 is northeast)
Reactor Building Foundation Drainage Sump	U*X* MK *YY*	*X* represents the unit associated with the sump *Y* is a unique identifier
Irradiated Fuel Bay Groundtube	IFBA-GT-*X*A IFBB-GT-*X*B	*X* is a unique identifier
TAB Foundation Drainage	IAD-SU-*X*-*Y*	*X* represents the unit associated with the foundation drainage *Y* represents the orientation of the drainage line (1 is north and 2 west)
TAB Inactive Drainage Sump	IAD-SU-*X*	*X* represents the unit associated with the sump

8.0 ACRONYMS

µCi/kg	Micro curie per Kilogram
Bq/L	Becquerel per Litre
BTEX	Benzene / Toluene / Ethylbenzene / Xylene
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
EMP	Environmental Monitoring Program
EPG	Emergency Power Generator
FWTPSB	Former Water Treatment Plan Settling Basin

HU	Hydrostratigraphic Unit
IAD	Inactive Drainage
IFB	Irradiated Fuel Bay
ISO	International Organization for Standardization
MDL	Method Detection Limit
MECP	Ministry of Environment, Conservation and Parks
ODWQS	Ontario Drinking Water Quality Standard
OPG	Ontario Power Generation Inc.
PHC	Petroleum Hydrocarbon
PNGS	Pickering Nuclear Generating Station
QA/QC	Quality Assurance/Quality Control
RAB	Reactor Auxiliary Bay
RB	Reactor Building
RLWMS	Radioactive Liquid Waste Management System
RPD	Relative Percentage Difference
SAP	Sampling and Analysis Plan
SRST	Spent Resin Storage Tank
TAB	Turbine Auxiliary Bay
UPP	Upgrading Plant Pickering
VB	Vacuum Building
VBRS	Vacuum Building Ramp Sump
VOC	Volatile Organic Compound
WSP	Water Supply Plant

Appendix A: Tables A-1 to A-9

Table A-1
Units 1 to 4 and Vacuum Building Areas
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW-064-21	Bq/L	--	NA	--	--
MW-157-12	Bq/L	--	NA	--	6,660
MW-158-34	Bq/L	--	NA	--	--
MW-159-14*	Bq/L	--	--	63,640	41,810,000
MW-160-22*	Bq/L	--	--	13,320	24,790
MW-161-48	Bq/L	NA	NA	NA	89,540
MW-209-13	Bq/L	4,440	--	--	--
MW-210-30	Bq/L	1,480	--	--	--
MW-215-12	Bq/L	NA	11,100	NA	10,730
MW-230-30	Bq/L	847,300	NA	717,800	754,800
MW-232-30*	Bq/L	--	--	1,709,400	
MW-234-30	Bq/L	2,090,500	NA	3,063,600	2,926,700
MW-235-30*	Bq/L			6,697,000	7,215,000
MW-237-30	Bq/L	6,771,000	NA	5,069,000	5,439,000
MW-238-30*	Bq/L	--	--	3,959,000	
MW-239-30	Bq/L	13,283,000	NA	10,952,000	11,063,000
MW-240-26	Bq/L	1,480	--	--	3,700
MW-241-25*	Bq/L	--	--	--	4,810
MW-242-25	Bq/L	377,400	NA	NA	NA
MW-243-29	Bq/L	113,220	NA	NA	58,090
MW-246-30	Bq/L	2,508,600	NA	NA	2,319,900
MW-247-35	Bq/L	2,657	--	--	--
MW-251-5	Bq/L	92,500	NA	NA	159,840
MW-257-5	Bq/L	3,011,800	NA	NA	3,108,000
MW-258-12*	Bq/L	--	--	1,576,200	--
MW-260-25	Bq/L	2,064,600	NA	1,964,700	2,127,500
MW-261-25	Bq/L	108,040	NA	25,900	140,970
MW-262-25*	Bq/L			4,773,000	8,510,000
MW-269-20	Bq/L	NA	2,960	NA	4,440
MW-270-20	Bq/L	21,016,000	NA	21,608,000	28,527,000
MW-271-20*	Bq/L	--	--	58,090,000	108,040,000
MW-272-20*	Bq/L	--	--	2,667,700	--
MW-273-20	Bq/L	2,090,500	NA	1,254,300	806,600
MW-301-15	Bq/L	NA	13,320	NA	21,460
MW-302-40	Bq/L	--	740	--	--
MW-313-40	Bq/L	NA	--	NA	--
MW-315-15	Bq/L	224,590	NA	NA	1,206,200
MW-318-40	Bq/L	NA	NA	NA	3,700
MW-320-20	Bq/L	8,140	NA	NA	5,550
MW-321-15	Bq/L	8,880	NA	NA	82,880
RBU2-GT-1	Bq/L	6,364,000	NA	1,653,900	2,730,600
RBU2-GT-4	Bq/L	13,875,000	NA	16,539,000	5,809,000
RBU3-GT-2	Bq/L	17,020	NA	15,540	11,470
RBU3-GT-3	Bq/L	NA	NA	NA	NA
RBU4-GT-2	Bq/L	37,370	NA	41,440	NA
RBU4-GT-3	Bq/L	27,750	NA	20,350	NA

U1-RBFD-1	Bq/L	44,030,000	30,858,000	377,400,000	278,610,000
U1-RBFD-2	Bq/L	48,100,000	36,223,000	177,970,000	138,380,000
U1-RBFD-3	Bq/L	7,844,000	3,034,000	4,255,000	71,410,000
U1-RBFD-4	Bq/L	NA	NA	NA	NA
VB Ramp Sump	Bq/L	NA	NA	1,132,200	NA

Notes:
-- denotes no sample required
NA denotes that results were not available because samples could not be collected
* denotes that samples were collected to support investigative work outside of the routine program

Table A-2
Unit 5 to 8 Areas
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW-102-15	Bq/L	8,880	--	--	--
MW-170-25	Bq/L	--	4,440	--	--
MW-180-40	Bq/L	740	--	--	--
MW-181-57	Bq/L	740	--	--	--
MW-186-12	Bq/L	--	6,660	--	--
MW-264-10	Bq/L	43,660	--	--	--
MW-265-12	Bq/L	5,550	--	--	--
MW-266-19	Bq/L	55,130	NA	56,980	70,670
MW-267-17	Bq/L	46,620	NA	37,740	24,790
MW-325-15	Bq/L	105,450	--	--	2,590
RBU5-GT-1	Bq/L	183,520	253,820	510,600	414,400
RBU5-GT-2	Bq/L	3,096,900	1,524,400	1,457,800	488,400
RBU5-GT-3	Bq/L	1,628,000	773,300	1,150,700	769,600
RBU5-GT-4	Bq/L	1,990,600	257,890	458,800	540,200
RBU6-GT-1	Bq/L	NA	NA	NA	NA
RBU6-GT-2	Bq/L	1,679,800	1,757,500	5,550,000	62,900,000
RBU6-GT-3	Bq/L	980,500	65,860	3,278,200	3,559,400
RBU6-GT-4	Bq/L	71,780	1,250,600	4,477,000	6,882,000
RBU7-GT-1	Bq/L	126,170	--	--	66,970
RBU7-GT-2	Bq/L	72,150	47,360	48,100	49,210
RBU7-GT-3	Bq/L	133,570	17,760	14,430	12,950
RBU7-GT-4	Bq/L	12,580	12,580	--	377,400
RBU8-GT-1	Bq/L	12,173,000	25,160	21,090	1,487,400
RBU8-GT-2	Bq/L	2,316,200	206,460	--	3,204,200
RBU8-GT-3	Bq/L	1,816,700	28,860	20,720	984,200
RBU8-GT-4	Bq/L	54,020	32,560	--	1,087,800
U5 MK 26	Bq/L	172,050	NA	338,180	NA
U6 MK 30	Bq/L	123,210	NA	1,073,000	3,692,600
U7 MK 36	Bq/L	15,170	NA	27,380	1,346,800
U8 MK 42	Bq/L	361,490	NA	562,400	1,513,300

Notes:
-- denotes no sample required
NA denotes that results were not available because samples could not be collected

Table A-3
Irriadiated Fuel Bays
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
014 IFB					
MW-056-18	Bq/L	7,400	--	NA	--
MW-057-30	Bq/L	9,250	NA	NA	6,660
MW-062-42	Bq/L	NA	--	--	--
MW-244-18	Bq/L	NA	--	--	--
IFBA-GT-1A	Bq/L	4,477,000	NA	4,218,000	3,996,000
IFBA-GT-2A	Bq/L	4,958,000	NA	2,982,200	NA
IFBA-GT-4A	Bq/L	18,500	NA	33,670	54,390
IFBA-GT-5A	Bq/L	24,050	NA	38,850	19,610
058 IFB					
MW-171-15	Bq/L	15,170	NA	15,910	32,930
MW-172-25	Bq/L	14,060	--	5,550	--
IFBB-GT-1B	Bq/L	72,150	NA	588,300	606,800
IFBB-GT-2B	Bq/L	321,160	NA	473,600	562,400
IFBB-GT-3B	Bq/L	38,850	NA	418,100	521,700
IFBB-GT-4B	Bq/L	119,140	NA	56,610	62,160
IFBB-GT-5B	Bq/L	166,870	NA	120,990	181,300
IFBB-GT-6B	Bq/L	78,070	NA	46,990	99,900

Notes:
-- denotes no sample required
NA denotes that results were not available because samples could not be collected

Table A-4
Upgrading Plant Pickering
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW-066-20	Bq/L	NA	--	--	--
MW-075-10	Bq/L	--	59,200	--	--
MW-076-20	Bq/L	--	64,750	--	--
MW-089-10	Bq/L	NA	--	--	--
MW-090-20	Bq/L	NA	NA	NA	219,410
MW-091-35	Bq/L	NA	--	--	--
MW-093-20	Bq/L	740	--	--	--
MW-096-20	Bq/L	16,650	--	--	--

Notes:
-- denotes no sample required

Table A-5
TAB Inactive Drainage
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
IAD-SU-1	Bq/L	10,360	NA	NA	11,100
IAD-SU-1-1	Bq/L	NA	NA	NA	NA
IAD-SU-1-2	Bq/L	NA	NA	NA	NA
IAD-SU-2	Bq/L	29,970	NA	21,460	17,020
IAD-SU-2-1	Bq/L	NA	NA	NA	NA
IAD-SU-2-2	Bq/L	NA	NA	NA	NA
IAD-SU-3	Bq/L	NA	NA	NA	15,540
IAD-SU-3-1	Bq/L	NA	NA	NA	NA
IAD-SU-3-2	Bq/L	NA	NA	NA	NA
IAD-SU-4	Bq/L	NA	NA	5,180	740
IAD-SU-4-1	Bq/L	NA	NA	NA	NA
IAD-SU-4-2	Bq/L	NA	NA	NA	NA
IAD-SU-5	Bq/L	6,290	NA	1,850	2,220
IAD-SU-5-1	Bq/L	NA	NA	NA	NA
IAD-SU-5-2	Bq/L	NA	NA	NA	NA
IAD-SU-6	Bq/L	5,550	NA	2,960	2,960
IAD-SU-6-1	Bq/L	NA	NA	NA	NA
IAD-SU-6-2	Bq/L	NA	NA	NA	NA
IAD-SU-7	Bq/L	24,050	NA	21,090	NA
IAD-SU-7-1	Bq/L	NA	NA	NA	NA
IAD-SU-7-2	Bq/L	NA	NA	NA	NA
IAD-SU-8	Bq/L	83,990	NA	65,490	48,840
IAD-SU-8-1	Bq/L	NA	NA	NA	NA
IAD-SU-8-2	Bq/L	NA	NA	NA	NA

Notes:
NA denotes that results were not available because samples could not be collected

Table A-6
Site Boundary Areas
2020 Tritium Results

Sample Location Name	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW-156-20	Bq/L	--	NA	--	--
MW-164-13	Bq/L	--	NA	--	4,440
MW-165-24*	Bq/L	--	NA	--	--
MW-176-23*	Bq/L	--	NA	--	--
MW-177-35*	Bq/L	--	NA	--	--
MW-183-10*	Bq/L	--	NA	--	--
MW-184-27*	Bq/L	--	NA	--	--
MW-185-39*	Bq/L	--	NA	--	--
MW-192-18*	Bq/L	--	NA	--	--
MW-193-37*	Bq/L	--	NA	--	--
MW-194-57*	Bq/L	--	NA	--	--
MW-195-73*	Bq/L	--	NA	--	--
MW-197-15	Bq/L	--	NA	--	--
MW-198-20*	Bq/L	--	NA	--	--
MW-199-38*	Bq/L	--	NA	--	--
MW-200-22*	Bq/L	--	NA	--	--
MW-201-39*	Bq/L	--	NA	--	--
MW-204-24*	Bq/L	--	NA	--	--
MW-205-35*	Bq/L	--	NA	--	--
MW-206-65*	Bq/L	--	NA	--	--
MW-207-87*	Bq/L	--	NA	--	--
MW-216-15*	Bq/L	--	NA	--	--
MW-217-32*	Bq/L	--	NA	--	--
MW-222-10*	Bq/L	--	NA	--	--
MW-223-32*	Bq/L	--	NA	--	--
MW-224-42*	Bq/L	--	NA	--	--
MW-225-12*	Bq/L	--	NA	--	--
MW-226-22	Bq/L	NA	4,440	NA	3,700
MW-227-40*	Bq/L	--	NA	--	--
MW-228-57*	Bq/L	--	NA	--	--
MW-229-70	Bq/L	--	NA	--	--

Notes:
-- denotes no sample required
NA denotes that results were not available because samples could not be collected
*Additional samples collected in Q1 2021. Refer to Section 3.3.

Table A-7
EPG Area
2020 Analytical Results

Sample Location Name	Parameter	Units	Quarter 3
MW-121-15	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA
MW-124-15	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA
MW-125-15	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA
MW-322-15	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA

Notes:
NA denotes that results were not available because samples could not be collected

Table A-8

Fukushima Diesel Generator Area

2020 Analytical Results

Sample Location Name	Parameter	Units	Quarter 3
MW-196-20	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA
MW-326-10	Benzene	ug/L	NA
	Toluene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	PHC F2 C10-C16	ug/L	NA
	PHC F3 C16-C34	ug/L	NA
	PHC F4 C34-C50	ug/L	NA

Notes:

NA denotes that results were not available because samples could not be collected

Table A-9
Quality Control Results

Parent and Duplicate Sample	Analyte	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
MW-057-30 Field Duplicate	H3	Bq/L	9,250	NA	NA	7,030
MW-057-30 Regular Sample	H3	Bq/L	9,250	NA	NA	6,660
Relative Percentage Difference			**0%**	NA	NA	**5%**
MW-076-20 Field Duplicate	H3	Bq/L	--	NA	--	--
MW-076-20 Regular Sample	H3	Bq/L	--	64,750	--	--
Relative Percentage Difference			--	NA	--	--
MW-156-20 Field Duplicate	H3	Bq/L	--	NA	--	--
MW-156-20 Regular Sample	H3	Bq/L	--	NA	--	--
Relative Percentage Difference			--	NA	--	--
MW-161-48 Field Duplicate	H3	Bq/L	NA	NA	NA	85,840
MW-161-48 Regular Sample	H3	Bq/L	NA	NA	NA	89,540
Relative Percentage Difference			NA	NA	NA	**4%**
MW-170-25 Field Duplicate	H3	Bq/L	--	4,070	--	--
MW-170-25 Regular Sample	H3	Bq/L	--	4,440	--	--
Relative Percentage Difference			--	**9%**	--	--
MW-192-18 Field Duplicate	H3	Bq/L	--	NA	--	--
MW-192-18 Regular Sample	H3	Bq/L	--	NA	--	--
Relative Percentage Difference			--	NA	--	--
MW-222-10 Field Duplicate	H3	Bq/L	--	NA	--	670
MW-222-10 Regular Sample	H3	Bq/L	--	NA	--	688
Relative Percentage Difference			--	NA	--	**3%**
MW-242-25 Field Duplicate	H3	Bq/L	584,600	NA	NA	NA
MW-242-25 Regular Sample	H3	Bq/L	377,400	NA	NA	NA
Relative Percentage Difference			**43%**	NA	NA	NA
MW-267-17 Field Duplicate	H3	Bq/L	45,880	NA	36,260	25,160
MW-267-17 Regular Sample	H3	Bq/L	46,620	NA	37,740	24,790
Relative Percentage Difference			**2%**	NA	**4%**	**1%**
MW-301-15 Field Duplicate	H3	Bq/L	NA	15,540	NA	23,310
MW-301-15 Field Sample	H3	Bq/L	NA	13,320	NA	21,460
Relative Percentage Difference			NA	**15%**	NA	**8%**
MW-325-15 Field Duplicate	H3	Bq/L	NA	--	--	--
MW-325-15 Field Sample	H3	Bq/L	105,450	--	--	--
Relative Percentage Difference			NA	--	--	--
IFBB-GT-1B Field Duplicate	H3	Bq/L	73,260	NA	588,300	603,100
IFBB-GT-1B Regular Sample	H3	Bq/L	72,150	NA	588,300	606,800
Relative Percentage Difference			**2%**	NA	**0%**	**1%**
VB Ramp Sump Field Duplicate	H3	Bq/L	NA	NA	NA	NA
VB Ramp Sump Regular Sample	H3	Bq/L	NA	NA	1,132,200	NA
Relative Percentage Difference			NA	NA	NA	NA
U7 MK 36 Field Duplicate	H3	Bq/L	16,650	NA	27,010	1,335,700
U7 MK 36 Regular Sample	H3	Bq/L	15,170	NA	27,380	1,346,800
Relative Percentage Difference			**9%**	NA	**1%**	**1%**
IAD-SU-1-1 Field Duplicate	H3	Bq/L	NA	NA	NA	NA
IAD-SU-1-1 Regular Sample	H3	Bq/L	NA	NA	NA	NA
Relative Percentage Difference			NA	NA	NA	NA

Notes:
-- denotes no sample required
NA denotes that results were not available because samples could not be collected

Table A-9

Quality Control Results

Sample Location Name	Parameter	Units	Quarter 3	Relative Percentage Difference
MW-121-15 Field Duplicate	Benzene	ug/L	NA	NA
MW-121-15 Regular Sample	Benzene	ug/L	NA	
MW-121-15 Field Duplicate	Ethylbenzene	ug/L	NA	NA
MW-121-15 Regular Sample	Ethylbenzene	ug/L	NA	
MW-121-15 Field Duplicate	M&p-xylenes	ug/L	NA	NA
MW-121-15 Regular Sample	M&p-xylenes	ug/L	NA	
MW-121-15 Field Duplicate	O-Xylene	ug/L	NA	NA
MW-121-15 Regular Sample	O-Xylene	ug/L	NA	
MW-121-15 Field Duplicate	PHC F1 C06-C10	ug/L	NA	NA
MW-121-15 Regular Sample	PHC F1 C06-C10	ug/L	NA	
MW-121-15 Field Duplicate	PHC F2 C10-C16	ug/L	NA	NA
MW-121-15 Regular Sample	PHC F2 C10-C16	ug/L	NA	
MW-121-15 Field Duplicate	PHC F3 C16-C34	ug/L	NA	NA
MW-121-15 Regular Sample	PHC F3 C16-C34	ug/L	NA	
MW-121-15 Field Duplicate	PHC F4 C34-C50	ug/L	NA	NA
MW-121-15 Regular Sample	PHC F4 C34-C50	ug/L	NA	
MW-121-15 Field Duplicate	Toluene	ug/L	NA	NA
MW-121-15 Regular Sample	Toluene	ug/L	NA	

<u>Notes:</u>

NA denotes that results were not available because samples could not be collected

Table A-9
Quality Control Results

Name	Reading Name	Units	Quarter 3
MW-125-15 Field Blank	Benzene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	Toluene	ug/L	NA
MW-125-15 Trip Blank	Benzene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	Toluene	ug/L	NA
MW-326-10 Field Blank	Benzene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	Toluene	ug/L	NA
MW-326-10 Trip Blank	Benzene	ug/L	NA
	Ethylbenzene	ug/L	NA
	M&p-xylenes	ug/L	NA
	O-Xylene	ug/L	NA
	PHC F1 C06-C10	ug/L	NA
	Toluene	ug/L	NA

Notes:
NA denotes that results were not available because samples could not be collected