IEMA-OHS

Illinois Emergency Management Agency
and Office of Homeland Security

2022 Radiological Environmental Monitoring Report of the Honeywell Metropolis Works Facility

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Executive Summary

The Illinois Emergency Management Agency and Office of Homeland Security (IEMA-OHS) is mandated with protecting public health and safety and the environment from the potentially harmful effects of ionizing radiation. In support of that mission, IEMA-OHS conducts radiological environmental monitoring around the Honeywell Metropolis Works (HMW) facility near Metropolis, Illinois.

IEMA-OHS's radiological environmental monitoring program has three primary functions: 1) collection of diverse samples from carefully chosen locations on a routine basis, including simultaneous field surveillance; 2) analyzing samples for radionuclides; and 3) evaluation of test results on both an annual and historical basis.

The HMW facility is located on the peripheries of the town Metropolis, in Massac County, Illinois. The site consists of a 60 acre restricted area and a total of 1100 acres of land in Massac County. HMW started nuclear fuel cycle activities in 1958 and HMW is unique in that it is the only facility in the United States that produces uranium hexafluoride (UF_6).

In March, 2018 the HMW plant was put in a ready-idle state and remained in that state throughout 2022. While in the ready-idle state the plant discontinued production, greatly reduced the amount of hazardous materials on-site, and conducts only minimal operations. Uranium ore continues to be received, sampled, assayed, and stored throughout the idle period. Security has been maintained, and emergency response capabilities are commensurate with the hazards on-site.

In February of 2021, Honeywell announced that they would be beginning the process of returning the plant to its operational state, with the goal of returning to production mode in early 2023.

Although the HMW facility is licensed by the US NRC, IEMA-OHS maintains a presence in the surrounding communities through its radiological environmental monitoring program. The overall purpose of IEMA-OHS's radiological environmental monitoring program, in relation to the HMW facility, is to determine the radiological environmental impact in the environs of the facility due to its operation, as well as determine long-term trends in environmental radiation levels.

In 2022, 289 environmental samples were collected and analyzed for radioactivity. The samples collected by IEMA-OHS included water, sediment, soil, air, and vegetation. In addition, 76 environmental dosimeters (Optically Stimulated Luminescence Dosimeters, or OSLs) were strategically deployed around the HMW facility to measure direct radiation.

With the exception of deposition soil samples collected in the second quarter from the Massac Creek location, a vegetation sample collected in the second quarter from the Airport location, and a vegetation sample collected during the third quarter from the Nearest Residence location, sampling and monitoring results collected as part of IEMA-OHS's HMW radiological environmental monitoring program indicate that radioactivity levels remain consistent with data collected in previous years.

Laboratory analysis of the second quarter Massac Creek deposition soil samples, although below background levels, indicated isotopic uranium levels at a slightly higher level than historical data collected. Results from the samples collected in the subsequent quarter were consistent with historical data.

The second quarter vegetation sampling from the Airport location indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data typically found at that location. Results from the sample collected in the subsequent quarter were consistent with background data.

Results for the third quarter vegetation sampling from the Nearest Residence location indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data previously collected from that location. IEMA-OHS will continue to sample, monitor, and track results from this location.

As seen in previous years, results from sampling and monitoring locations found near the HMW facility indicate slightly elevated levels of radioactivity in the soil and air when compared to samples collected from greater distances away from the facility or from background reference areas. Similarly, direct radiation monitoring near the facility shows a slight increase in exposure in those areas when compared to other monitoring locations found away from the plant and background reference areas.

IEMA-OHS will continue to monitor the environs of, and evaluate its radiological environmental monitoring program for, the HMW facility to ensure that the site is performing as expected and that the citizens and environment of Illinois are protected from the potentially harmful effects of radioactive materials released from the facility.

In 2022, sampling and monitoring results collected as part of IEMA's HMW radiological environmental monitoring program indicate that radioactivity levels remain consistent at most sampling locations, with inconsistencies identified as slightly higher isotopic uranium results seen in vegetation samples from the Airport and Nearest Residence locations and slightly elevated results seen in deposition soil samples collected from the Massac Creek sampling location.

Introduction

The Illinois Emergency Management Agency and Office of Homeland Security (IEMA-OHS) is charged with protecting the citizens of Illinois from the potentially harmful effects of radioactive materials. In support of that mission, IEMA-OHS's Office of Nuclear Safety's Radiological Field Services Unit (RFS) monitors the environment in Illinois for the presence of radionuclides through its radiological environmental monitoring program. This program has three primary functions: 1) collection of diverse samples from carefully chosen locations on a routine basis; 2) analyzing samples for radionuclides; and 3) evaluation of test results on both an annual and historical basis.

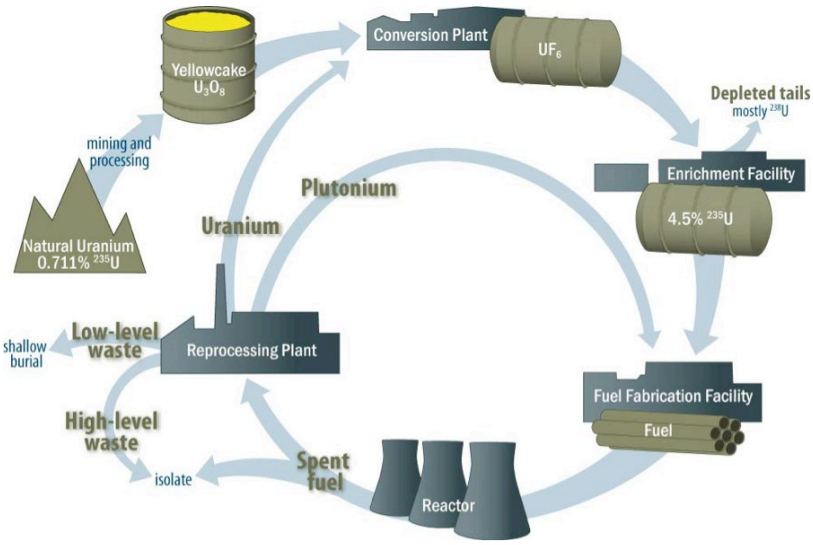
One of the locations monitored by IEMA-OHS is the environs of the Honeywell Metropolis Works (HMW) Facility near Metropolis, Illinois. The purpose of this report is to provide updated results of monitoring conducted during calendar year 2022.

Site Description

Located on approximately 1,100 acres of land within Massac County and on the peripheries of Metropolis, Illinois, the HMW facility perimeter is formed by U.S. Highway 45 to the north, the Ohio River to the south, a coal terminal to the west, and the city of Metropolis to the east. The facility footprint and the land immediately surrounding the facility form a 60-acre restricted area as required by HMW's United States Nuclear Regulatory Commission's (US NRC) Radioactive Materials License, number SUB-526. This restricted area is intended for the protection of the public from exposure to radiation and radioactive materials.

Opened in 1958, the HMW, a subsidiary company of Honeywell International Inc., plays a crucial role in the nuclear fuel cycle by converting uranium ore (U_3O_8) into uranium hexafluoride (UF_6). HMW is unique in that it is the only facility in the United States that produces UF_6. As depicted in Figure 1, conversion is the second step in the nuclear fuel cycle immediately following mining and processing and preceding enrichment.

Figure 1. Nuclear Fuel Cycle



HMW uses a dry conversion process to convert U_3O_8 to UF_6. The process first strips the U_3O_8 of impurities such as sodium and potassium. The material is then treated with nitrogen to form UO_2 and then hydrofluorinated with hydrofluoric acid to form uranium tetrafluoride (UF_4). The UF_4 is treated with fluorine gas to form UF_6. After HMW converts U_3O_8 into UF_6, the UF_6 is then processed, packaged and transported to enrichment plants, both domestic and foreign, where the UF_6 is enriched either by gaseous diffusion or gas centrifugation. The enriched UF_6 is then sent to fuel fabrication facilities and processed into fuel pellets for nuclear power plants.

In 2017, Honeywell announced plans to idle the HMW plant. Preparation for the idle state began late in the year, with the plant reaching a ready idle state in March of 2018. Full uranium hexafluoride cylinders continued to be shipped through March 2018. During the ready-idle state, the plant is conducting minimal operations and the amount of hazardous materials on site has been greatly reduced. Uranium ore will continue to be received, sampled, assayed, and stored throughout the idle period. Security is being maintained, and emergency response capabilities remain commensurate with the hazards on site. In February 2021, Honeywell announced the plant would start the process of going operational with the goal of being in production mode in early 2023.

Although the HMW facility is licensed by the US NRC, IEMA-OHS maintains a presence in the surrounding communities through its radiological environmental monitoring program. The overall purpose of IEMA-OHS's radiological environmental monitoring program, in relation to the HMW facility, is to determine the radiological environmental impact in the environs of the facility due to its operation, as well as determine long-term trends in environmental radiation levels.

IEMA-OHS Radiological Environmental Monitoring Program

The IEMA-OHS radiological environmental monitoring program consists of sample collection and laboratory analysis, as well as review and analysis of the resulting data. As part of the 2022 HMW radiological environmental monitoring program, samples were collected from various locations around the HMW facility and the greater Metropolis area. Appendix A contains maps of the area around the HMW plant that indicate IEMA-OHS's sampling locations.

Sampling included water, vegetation, air, direct radiation, soil, and sediment. Analyses vary from media to media but focus primarily on natural uranium. A general description of sample collection, analysis, and results follows. Sample result tables are located in Appendix B and C.

Sampling and Monitoring Activities

Air Sampling

Air particulate samples are collected from a network of five strategically positioned environmental monitoring stations (EMS) within the environs of HMW. Each EMS is comprised of a continuous low-volume vacuum pump and air filter assembly. Particulate filter samples are exchanged and analyzed weekly.

Soil Sampling

Soil samples are collected from four sampling locations during the second and third quarters of the year and analyzed for radionuclides that may have been transported from the environment and incorporated into the soil. Soil is sampled at a depth of six inches to monitor the migration of radionuclides away from the soil surface and at one inch to monitor for deposition of radionuclides on the soil surface.

Sediment Sampling

Sediment samples are collected from two sampling locations during the second and third quarters of the year to determine whether contaminants previously in solution or suspension have settled out of a body of water and, therefore, cannot be identified through water sampling.

Vegetation Sampling

Vegetation samples are collected from four sampling locations during the second and third quarters of the year and analyzed for radionuclides that may have been transported from the environment and incorporated into or on plant tissue.

Water Sampling

Water samples are collected quarterly from five sampling locations and analyzed to ensure that radionuclides attributable to the HMW facility have not migrated into off-site water sources.

Direct Radiation Monitoring

Unlike the environmental samples described above, dosimeters do not provide information on what radionuclides are found in the environment. Instead, dosimeters provide a direct measurement of the total dose produced by all sources of gamma radiation, including naturally occurring radionuclides and cosmic rays. A network of nineteen optically-stimulated luminescent dosimeters (OSLs) is arrayed around the HMW facility; dosimeters are exchanged and analyzed quarterly.

Background Reference Areas

IEMA-OHS has established the environs of Sangchris Lake State Park, a cooling lake for a coal-fired power station near Kincaid, Illinois, as the background sampling and monitoring location for water, soil, sediment, and vegetation samples, as well as for direct radiation monitoring. Air monitoring stations in Springfield, Marion, and West Chicago, Illinois are used for background reference locations for air samples. To establish background radiation levels, samples are collected and analyzed utilizing the same procedures and methodologies used for the HMW samples.

In October of 2018, IEMA-OHS collected deposition and migration soil samples from ten locations in and around Massac County, in order to establish a background soil concentration that better represents the area. Results from these samples are used to determine analytical thresholds and for data comparison purposes. Results can be found in IEMA-OHS's 2018 Radiological Environmental Monitoring Report of the Honeywell Metropolis Works Facility Report.

Results for 2022 background samples can be found in Appendix C.

Sampling and Monitoring Adjustments

The following adjustment was made to the HMW monitoring plan in 2022:

- METR-32 was permanently removed from the network of OSLs around the HMW facilty in the 4th quarter. METR-32 was removed due to worker safety concerns regarding the exchange of dosimetry along the busy stretch of Highway 45, and because of its close proximity of other OSLs in the area.

General Sampling and Monitoring Information

Every effort is made to collect all scheduled environmental samples; however, occasionally samples are unobtainable due to weather conditions, water levels, or obstructed access.

Laboratory Analysis

Soil, sediment, vegetation, water, and air samples were analyzed by the IEMA-OHS Radiochemistry Laboratory located in Springfield, Illinois. The laboratory participates in semi-annual proficiency testing programs through Environmental Resource Associates, an accredited proficiency testing provider, and the Department of Energy (DOE) Radiological and Environmental Science Laboratory's Mixed Analyte Performance Evaluation Program (MAPEP). A general description of each analysis performed is provided below.

Gross Alpha/Beta Analysis

Air particulate filters are exchanged and analyzed weekly for airborne radioactivity through gross alpha and beta analysis using a gas proportional counter. Since radionuclides associated with natural uranium emit either alpha or beta particles, analysis of air particulate samples for gross alpha/beta activity provides a good method of screening for the presence of radioactive materials.

Two "trigger" levels are used to determine if additional analysis is required for air particulate samples. These levels represent approximately 25% and 100% of the total uranium effluent concentration limit of 90 femtocurie per cubic meter (fCi/m^3) established in 10 Code of Federal Regulation Part 20, Appendix B.

Gross Alpha Trigger Levels:

- Gross alpha results at or above 25 fCi/m^3 are evaluated to determine if isotopic uranium analysis will need to be performed.
- Samples with gross alpha results at or above 90 fCi/m^3 require isotopic uranium analysis.

Isotopic Uranium Analysis

Isotopic uranium analysis via alpha spectroscopy is used to determine specific uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238) concentrations. All soil, vegetation, water, and sediment samples are analyzed using this method. If previously specified trigger levels are exceded, air samples are also analayzed using this method.

Ingrowth Analysis

Soil and sediment samples that exceed the Isotopic Uranium Action Level set by IEMA-OHS (see below) are sealed and stored for at least 28 days to allow for the ingrowth of daughter products and then reanalyzed to identify and quantify Radium-226 (Ra-226) and Thorium-230 (Th-230). Ingrowth analysis is conducted using a high-purity germanium detector in a process called gamma spectroscopy. Due to issues with sealing vegetation sample containers, vegetation samples are not currently submitted for ingrowth analysis.

Isotopic Uranium Action Level:

The Isotopic Uranium Action Level is based on the results obtained from background samples collected in 2018 from several southern Illinois locations. The trigger limit has been set at 5 picocuries per gram (pCi/g) for combined (total) uranium (U-234 + U-235 + U-238) which is approximately twice the average isotopic uranium background level found in that area of the state.

Note: All soil samples taken from the Nearest Residence sample location are submitted for ingrowth analysis.

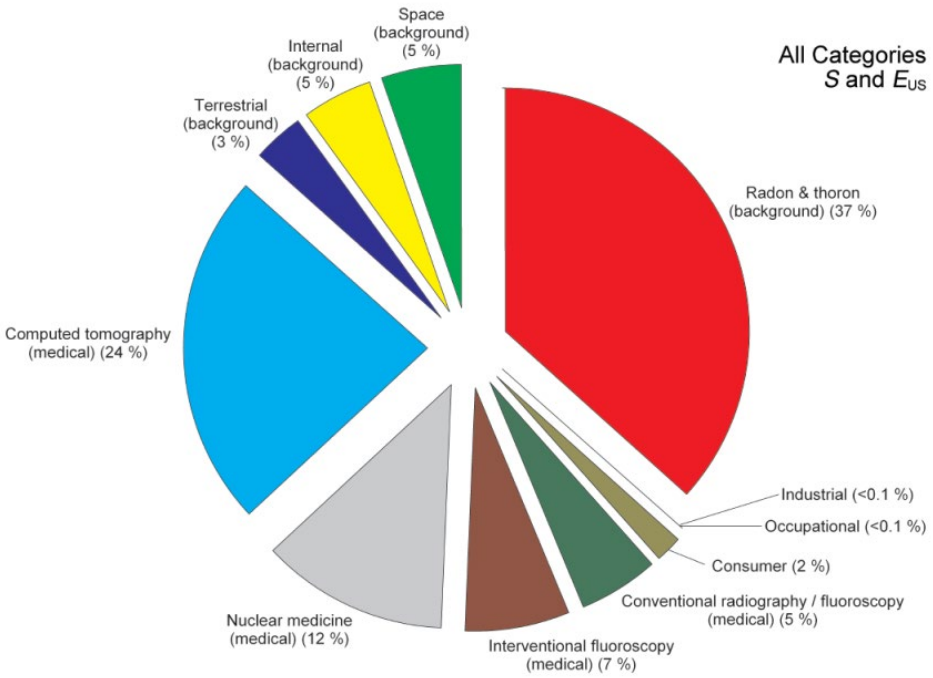
Optically Stimulated Luminescence Analysis

OSL dosimeters provide a direct measurement of the total dose received from all sources of gamma radiation, including naturally occurring radionuclides and cosmic rays. The dosimeters are used to monitor for changes in ambient background levels of gamma radiation that could result from releases of radioactive material or exposure to large quantities of stored material on site.

OSLs are analyzed by RFS staff using a Landauer In Light System Auto Reader. Results are expressed as the average milliroentgen (mR) per quarter and are also calculated to the approximate mR per year that would have been accrued by an individual at that location for an entire year.

The ambient gamma results can be compared to the average annual radiation exposure to an individual of 620 mR/year from various sources (according to the 2009 National Council on Radiation Protection's (NCRP) Report 160, see Figure 2). Approximately 8% (49.6 mR/year) of that exposure is from Terrestrial and Cosmic radiation (background radiation).

Figure 2. Sources of Radiation Exposure to Man



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Minimum Detectable Concentration

All analytical methods have limitations: amounts that are too small to be detected. The Minimum Detectable Concentration (MDC) is an "a priori" measure of that limitation – an estimate of the lower limit of detection. It is defined as the smallest quantity that an analytical method has 95% likelihood of detecting. For example, if the MDC for the IEMA-OHS Radiochemistry Laboratory's method for tritium in water is 200 picocuries per liter (pCi/L), given a sample with a tritium concentration of 200 pCi/L, we can expect to detect tritium approximately 95 times out of 100. Samples with less than 200 pCi/L could be detected, but with less certainty. Conversely, samples with more than 200 pCi/L would be more likely to be detected, approaching 100% as concentrations increase. Analytical methods are chosen, in part, on their MDC. As a general rule, methods are chosen such that their MDC is less than 10% of any applicable regulatory limit.

Analysis Adjustments

No adjustments were made to the HMW laboratory analysis in 2022:

Radiological Environmental Sampling and Monitoring Results

Air Sampling Results

Air particulate sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference locations. Results from each of the five air monitoring stations are displayed in Appendix B -Tables B.1 – B.5. Results for background location air sampling are located in Appendix C- Tables C1-C3.

Results are comparable to those obtained from background EMS locations in Marion, Springfield and West Chicago, Illinois, and are consistent with data previously collected by IEMA-OHS as part of its HMW radiological environmental monitoring program. All air particulate sample results for 2022 remain below the trigger levels established by IEMA-OHS.

Soil Sampling Results

Soil sample results are compared to historical data collected from the environs of the HMW facility, sample data collected from the background reference location, and to sample data collected from soil sampling performed in October 2018 to establish an area wide background concentration level. The area wide average background concentration determined through isotopic uranium analysis is 1.00 pCi/g of U-234, 0.05 pCi/g of U-235, and 1.02 pCi/g of U-238. The average area wide background concentration determined via ingrowth analysis is 1.09 pCi/g of Ra-226 and below the established MDC for Th-230. Analytical results for soil samples collected in 2018 to establish an area wide background concentration level can be found in IEMA-OHS's 2018 Radiological Environmental Monitoring Report of the Honeywell Metropolis Works Facility Report.

Analytical results for isotopic uranium analysis of soil are shown in Appendix B- Table B.6 and B.7. Results for background location soil sampling are located in Appendix C- Tables C.4 and C.5. Analytical results for gamma spectroscopy analysis of soil are shown in Appendix B- Table B.8 and B.9. Results for background location soil sampling are located in Appendix C- Tables C.6 and C.7.

Isotopic uranium deposition and migration results for samples collected from the airport location were slightly higher than results from background samples collected and the results from the 2018 area-wide background sampling study. Results from this location were consistent with historical data collected.

Isotopic uranium deposition and migration results for samples collected from the intersection of Gurley and Devers sampling location were generally consistent with background sample results, 2018 area-wide background sampling results, and historical data.

Isotopic uranium deposition and migration results for samples collected from the Massac Creek location were generally lower than results from background samples collected and the results from the 2018 area-wide background sampling study. Deposition sample results from this location, although below background levels, were slightly higher than historical data collected. Results from the deposition samples collected in the subsequent quarter were consistent with historical data. Migration sample results were consistent with historical data.

Isotopic uranium deposition and migration results for samples collected from the nearest residence location were higher than results from background samples collected and the results from the 2018 area-wide background sampling study. Results from this location were consistent with historical data collected.

Gamma spectroscopy results for soil deposition and soil migration samples after ingrowth of radioactive progeny are comparable to results obtained from the background sampling locations and are consistent with data previously collected by IEMA-OHS as part of its HMW radiological environmental monitoring program.

Sediment Sampling Results

Sediment sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results are shown in Appendix B- Table B.10. Results for background location sediment sampling are located in Appendix C- Table C.8.

Results are consistent with results obtained from the background samples collected from the West Boat Ramp in Kincaid, IL and to historical data collected. Results for samples collected from the Strawkaws Boat Ramp in Kincaid, IL are consistently lower than results from the West Boat Ramp and those collected in the environs of HMW.

Vegetation Sampling Results

Vegetation sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results are shown in Appendix B- Table B.11. Results for background location vegetation sampling are located in Appendix C- Tables C.9.

The 5/16/2022 vegetation sampling from the Airport location indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data previously collected from that location. Results from the sample collected in the subsequent quarter were consistent with background data.

Results for the 9/6/2022 vegetation sampling from the Nearest Residence location also indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data previously collected from that location. IEMA-OHS will continue to sample, monitor, and track results from this location.

All other results are consistent with results obtained from the background sampling locations and to historical data collected.

Water Sampling Results

Water sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results for water samples are displayed in Appendix B- Table B.12. Results for background location water sampling are located in Appendix C- Tables C.10.

Results are consistent with results obtained from the background sampling locations and to historical data collected.

Direct Radiation Monitoring Results

OSL results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results are displayed in Appendix B- Table B.13. Results for background location direct radiation monitoring are located in Appendix C- Tables C.11.

Results are consistent with results obtained from the background sampling locations and to historical data collected.

Results Interpretation or Limit Adjustments

No results interpretations or limit adjustments were made to the HMW result's analysis in 2022.

Summary

With the exception of deposition soil samples collected in the second quarter from the Massac Creek location, a vegetation sample collected in the second quarter from the Airport location, and a vegetation sample collected during the third quarter from the Nearest Residence location, sampling and monitoring results collected as part of IEMA-OHS's HMW radiological environmental monitoring program indicate that radioactivity levels remain consistent with data collected in previous years.

Laboratory analysis of the second quarter Massac Creek deposition soil samples, although below background levels, indicated isotopic uranium levels at a slightly higher level than historical data collected. Results from the samples collected in the subsequent quarter were consistent with historical data.

The second quarter vegetation sampling from the Airport location indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data typically found at that location. Results from the sample collected in the subsequent quarter were consistent with background data.

Results for the third quarter vegetation sampling from the Nearest Residence location indicated isotopic uranium levels at a higher concentration than results seen in background samples and in data previously collected from that location. IEMA-OHS will continue to sample, monitor, and track results from th location.

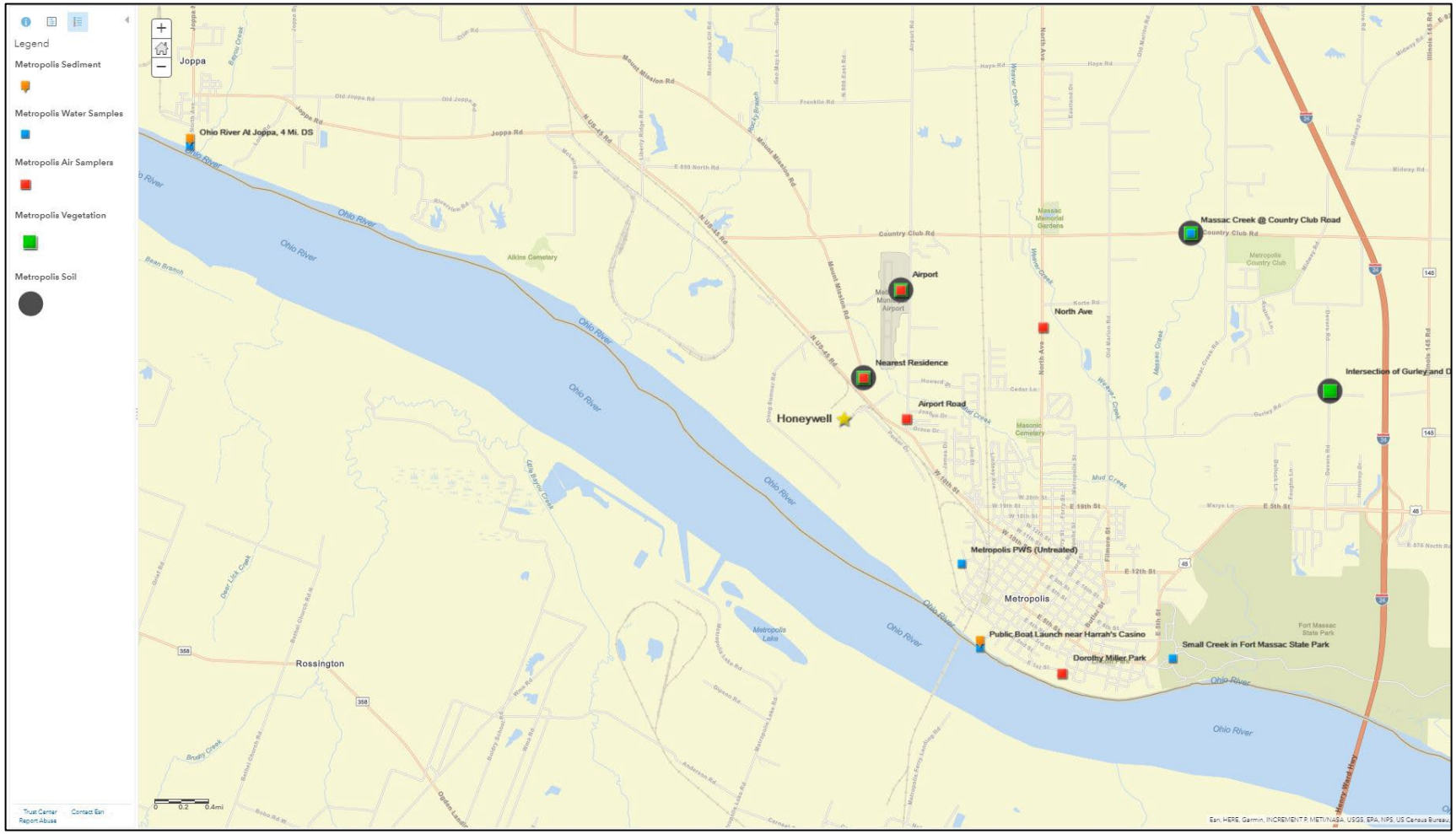
As seen in previous years, results from sampling and monitoring locations found near the HMW facility indicate slightly elevated levels of radioactivity in the soil and air when compared to samples collected from greater distances away from the facility or from background reference areas. Similarly, direct radiation monitoring near the facility shows a slight increase in exposure in those areas when compared to other monitoring locations found away from the plant and background reference areas.

In March, 2018 the HMW plant was put in a ready-idle state and remained in that state throughout 2022. While in the ready-idle state the plant discontinued production, greatly reduced the amount of hazardous materials on-site, and conducts only minimal operations. Uranium ore continues to be received, sampled, assayed, and stored throughout the idle period. Security has been maintained, and emergency response capabilities are commensurate with the hazards on-site.

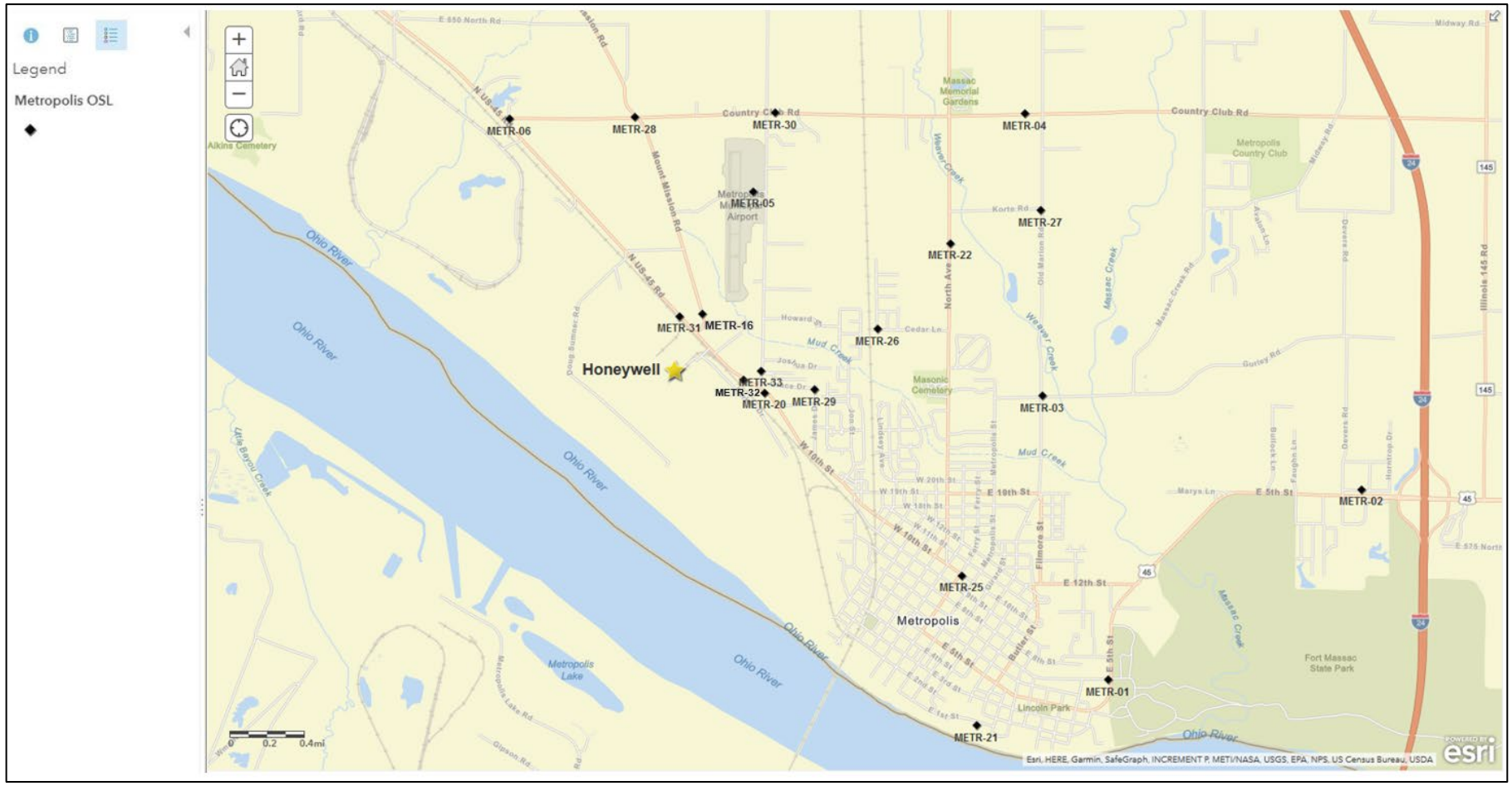
In February of 2021, Honeywell announced that they would be beginning the process of returning the plant to its operational state, with the goal of returning to production mode in early 2023.

APPENDIX A
Maps of Monitoring and Sampling Locations

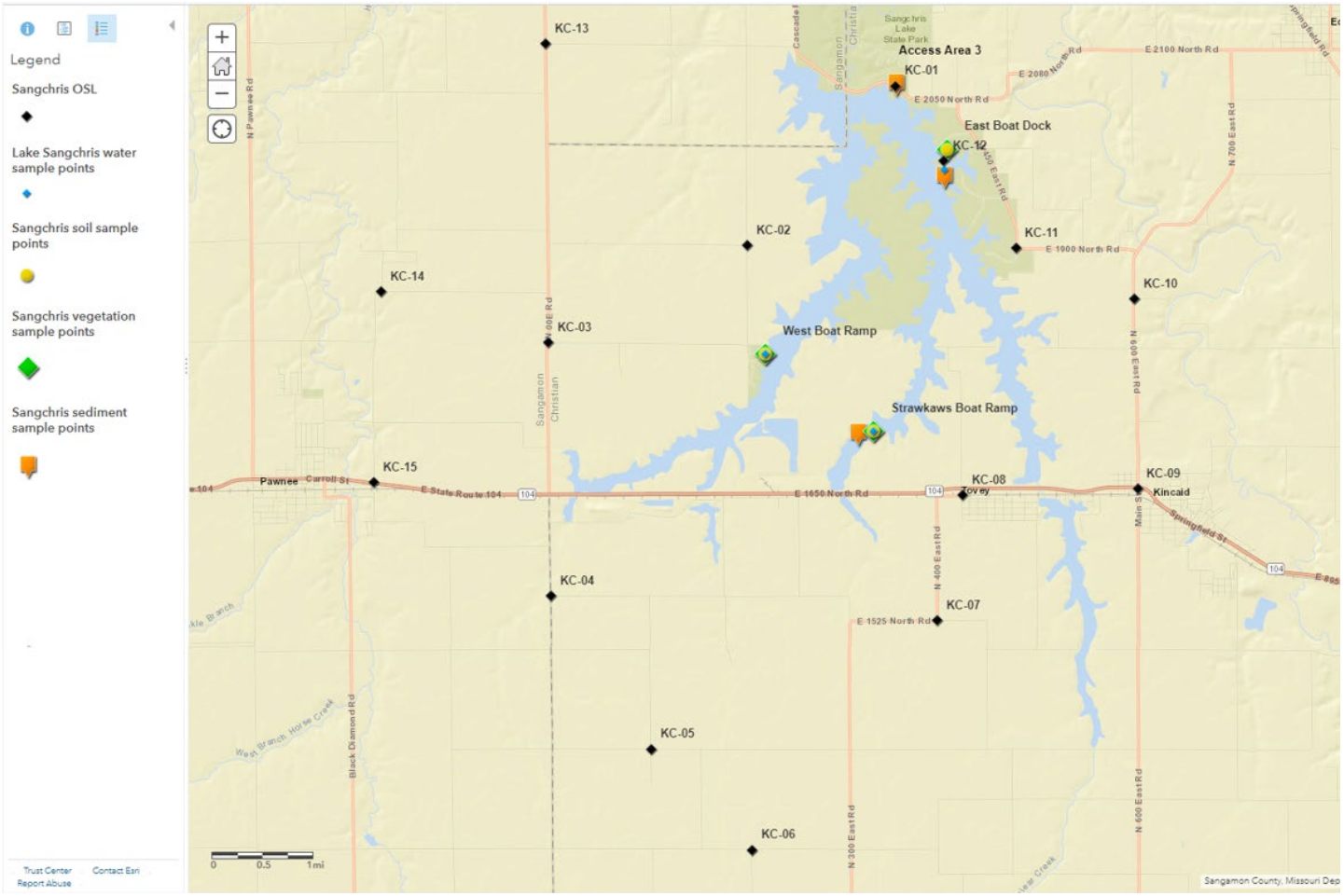
Map A.1. Honeywell Metropolis Works Sampling Locations



Map A.2. Honeywell Metropolis Works Optically Stimulated Luminescence Monitoring Locations



Map A.3. Background Reference Sampling Locations: Sangchris Lake State Park near Kincaid, Illinois



APPENDIX B
Sample Analysis Results for Samples Collected from the Environs of the HMW Facility

Table B.1 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Nearest Residence
Results are in femtocuries per cubic meter (fCi/m^3)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Nearest Residence				
1/3/2022	6.5	2.4	32.9	5.5
1/10/2022	6.3	2.4	48.8	5.5
1/18/2022	4.9	2.4	40.0	5.5
1/25/2022	4.8	2.4	31.2	5.5
1/31/2022	7.1	2.4	43.8	5.5
2/7/2022	5.8	2.4	33.9	5.5
2/14/2022	4.3	2.4	29.1	5.5
2/22/2022	3.7	2.4	25.1	5.5
3/1/2022	3.9	2.4	24.9	5.5
3/7/2022	7.5	2.4	46.7	5.5
3/14/2022	3.8	2.4	24.4	5.5
3/21/2022	<MDC	2.4	19.7	5.5
3/29/2022	<MDC	2.4	14.9	5.5
4/4/2022	<MDC	2.4	14.3	5.5
4/11/2022	2.9	2.4	11.8	5.5
4/25/2022	3.5	2.4	18.3	5.5
5/3/2022	4.8	2.4	17.8	5.5
5/9/2022	<MDC	2.4	7.0	5.5
5/16/2022	5.9	2.4	24.6	5.5
6/6/2022	3.0	2.4	19.4	5.5
6/13/2022	2.5	2.4	17.4	5.5
6/21/2022	4.2	2.4	22.5	5.5
6/27/2022	3.0	2.4	24.0	5.5

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Nearest Residence				
7/5/2022	3.4	2.4	19.3	5.5
7/11/2022	3.1	2.4	15.8	5.5
7/19/2022	3.8	2.4	26.5	5.5
7/26/2022	5.1	2.4	25.7	5.5
8/1/2022	2.6	2.4	16.0	5.5
8/9/2022	<MDC	2.4	13.5	5.5
8/16/2022	2.9	2.4	26.0	5.5
8/23/2022	2.9	2.4	32.9	5.5
9/12/2022	2.6	2.4	28.7	5.5
9/26/2022	5.7	2.4	24.3	5.5
10/3/2022	2.9	2.4	16.8	5.5
10/11/2022	3.7	2.4	30.7	5.5
10/24/2022	5.0	2.4	28.4	5.5
10/31/2022	6.7	2.4	23.0	5.5
11/7/2022	10.6	2.4	40.8	5.5
11/14/2022	5.1	2.4	19.2	5.5
11/21/2022	6.0	2.4	27.1	5.5
11/28/2022	9.9	2.4	43.9	5.5
12/6/2022	6.9	2.4	33.8	5.5
12/13/2022	9.0	2.4	43.4	5.5
12/20/2022	5.0	2.4	21.2	5.5
12/27/2022	5.2	2.4	25.5	5.5

Table B.2 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Metropolis Airport
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport 1 Mi. NNE				
1/3/2022	5.6	2.8	34.5	6.2
1/10/2022	5.3	2.8	43.1	6.2
1/18/2022	4.6	2.8	43.1	6.2
1/25/2022	3.6	2.8	35.1	6.2
1/31/2022	5.5	2.8	36.9	6.2
2/7/2022	4.9	2.8	33.1	6.2
2/14/2022	4.2	2.8	28.9	6.2
2/22/2022	<MDC	2.8	20.0	6.2
3/1/2022	3.9	2.8	28.0	6.2
3/7/2022	7.2	2.8	48.8	6.2
3/14/2022	4.2	2.8	26.9	6.2
3/21/2022	<MDC	2.8	18.5	6.2
3/29/2022	<MDC	2.8	17.3	6.2
4/4/2022	<MDC	2.8	15.5	6.2
4/11/2022	<MDC	2.8	13.0	6.2
4/18/2022	<MDC	2.8	12.6	6.2
4/25/2022	3.4	2.8	19.2	6.2
5/3/2022	4.3	2.8	18.4	6.2
5/9/2022	<MDC	2.8	8.2	6.2
5/16/2022	4.6	2.8	23.0	6.2
5/24/2022	3.3	2.8	19.2	6.2
5/31/2022	<MDC	2.8	14.8	6.2
6/6/2022	<MDC	2.8	18.6	6.2
6/13/2022	<MDC	2.8	18.6	6.2
6/27/2022	<MDC	2.8	23.4	6.2

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport 1 Mi. NNE				
7/5/2022	<MDC	2.8	19.8	6.2
7/11/2022	<MDC	2.8	16.7	6.2
7/19/2022	3.3	2.8	26.7	6.2
7/26/2022	4.4	2.8	25.6	6.2
8/1/2022	<MDC	2.8	15.9	6.2
8/9/2022	<MDC	2.8	14.9	6.2
8/16/2022	3.8	2.8	29.1	6.2
8/23/2022	2.8	2.8	35.4	6.2
8/31/2022	7.0	2.8	30.2	6.2
9/6/2022	4.4	2.8	25.1	6.2
9/12/2022	3.0	2.8	27.2	6.2
9/19/2022	<MDC	2.8	34.2	6.2
9/26/2022	4.9	2.8	24.6	6.2
10/3/2022	<MDC	2.8	18.6	6.2
10/11/2022	4.4	2.8	30.2	6.2
10/24/2022	4.7	2.8	28.1	6.2
10/31/2022	6.5	2.8	21.9	6.2
11/7/2022	9.4	2.8	40.5	6.2
11/14/2022	5.5	2.8	20.5	6.2
11/21/2022	6.4	2.8	29.9	6.2
11/28/2022	9.1	2.8	45.4	6.2
12/6/2022	6.8	2.8	37.0	6.2
12/13/2022	8.3	2.8	45.2	6.2
12/20/2022	5.6	2.8	22.4	6.2
12/27/2022	5.2	2.8	26.0	6.2

Table B.3 Sample Results for Alpha / Beta Screening of Air Particulate Filters
North Avenue
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Fire Station North Ave				
1/3/2022	4.5	1.6	33.5	4.6
1/10/2022	5.7	1.6	49.8	4.6
1/18/2022	6.1	1.6	40.1	4.6
1/25/2022	3.7	1.6	32.9	4.6
1/31/2022	5.9	1.6	36.2	4.6
2/7/2022	4.4	1.6	32.6	4.6
2/14/2022	4.6	1.6	31.0	4.6
2/22/2022	3.9	1.6	26.7	4.6
3/1/2022	4.7	1.6	26.8	4.6
3/7/2022	6.8	1.6	40.7	4.6
3/14/2022	4.5	1.6	27.4	4.6
3/21/2022	2.2	1.6	20.4	4.6
3/29/2022	1.9	1.6	17.0	4.6
4/4/2022	2.1	1.6	13.5	4.6
4/11/2022	2.4	1.6	12.0	4.6
4/18/2022	2.6	1.6	14.2	4.6
4/25/2022	3.3	1.6	18.9	4.6
5/3/2022	4.2	1.6	21.2	4.6
5/9/2022	<MDC	1.6	7.5	4.6
5/16/2022	4.4	1.6	23.3	4.6
5/24/2022	3.0	1.6	20.1	4.6
5/31/2022	2.1	1.6	14.8	4.6
6/6/2022	2.8	1.6	19.9	4.6
6/13/2022	2.2	1.6	19.4	4.6
6/21/2022	4.4	1.6	24.5	4.6
6/27/2022	2.5	1.6	25.1	4.6

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Fire Station North Ave				
7/5/2022	2.6	1.6	21.2	4.6
7/11/2022	3.5	1.6	18.7	4.6
7/19/2022	3.8	1.6	26.9	4.6
7/26/2022	4.8	1.6	29.2	4.6
8/1/2022	2.2	1.6	16.5	4.6
8/9/2022	1.9	1.6	14.1	4.6
8/16/2022	3.7	1.6	28.6	4.6
8/23/2022	2.5	1.6	33.1	4.6
8/31/2022	5.5	1.6	31.1	4.6
9/6/2022	4.5	1.6	25.5	4.6
9/12/2022	2.4	1.6	27.4	4.6
9/19/2022	2.0	1.6	32.7	4.6
9/26/2022	4.9	1.6	22.8	4.6
10/3/2022	3.4	1.6	16.6	4.6
10/11/2022	4.2	1.6	31.2	4.6
10/24/2022	4.4	1.6	28.6	4.6
10/31/2022	7.0	1.6	23.7	4.6
11/7/2022	3.8	1.6	12.4	4.6
11/14/2022	4.2	1.6	21.2	4.6
11/21/2022	6.7	1.6	28.1	4.6
11/28/2022	10.6	1.6	46.7	4.6
12/6/2022	7.0	1.6	37.2	4.6
12/13/2022	9.5	1.6	45.7	4.6
12/20/2022	5.0	1.6	20.4	4.6
12/27/2022	3.6	1.6	26.4	4.6

Table B.4 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Dorothy Miller Park
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Dorothy Miller Park				
1/3/2022	5.5	2.0	32.5	4.6
1/10/2022	5.2	2.0	44.8	4.6
1/18/2022	3.9	2.0	42.9	4.6
1/25/2022	3.2	2.0	32.0	4.6
1/31/2022	7.3	2.0	41.2	4.6
2/7/2022	4.3	2.0	26.2	4.6
2/14/2022	3.9	2.0	30.1	4.6
2/22/2022	2.6	2.0	26.9	4.6
3/1/2022	4.3	2.0	26.5	4.6
3/7/2022	5.0	2.0	37.1	4.6
3/14/2022	3.7	2.0	25.3	4.6
3/21/2022	3.6	2.0	17.5	4.6
3/29/2022	<MDC	2.0	16.0	4.6
4/4/2022	2.5	2.0	14.3	4.6
4/11/2022	2.0	2.0	11.2	4.6
4/18/2022	2.8	2.0	12.3	4.6
4/25/2022	2.5	2.0	18.1	4.6
5/3/2022	4.9	2.0	19.4	4.6
5/9/2022	<MDC	2.0	<MDC	4.6
5/24/2022	2.4	2.0	12.3	4.6
6/6/2022	2.8	2.0	18.2	4.6
6/13/2022	2.0	2.0	18.2	4.6
6/21/2022	4.1	2.0	22.9	4.6
6/27/2022	3.3	2.0	28.2	4.6
7/5/2022	<MDC	2.0	17.7	4.6

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Dorothy Miller Park				
7/11/2022	3.1	2.0	16.6	4.6
7/19/2022	3.9	2.0	27.3	4.6
7/26/2022	4.4	2.0	26.2	4.6
8/1/2022	2.0	2.0	16.4	4.6
8/9/2022	<MDC	2.0	13.8	4.6
8/16/2022	3.4	2.0	24.6	4.6
8/23/2022	2.5	2.0	32.2	4.6
8/31/2022	6.3	2.0	34.2	4.6
9/6/2022	4.7	2.0	22.4	4.6
9/12/2022	2.4	2.0	25.3	4.6
9/19/2022	3.1	2.0	34.5	4.6
9/26/2022	5.9	2.0	22.3	4.6
10/3/2022	3.2	2.0	17.5	4.6
10/11/2022	5.5	2.0	28.6	4.6
10/24/2022	4.2	2.0	26.9	4.6
10/31/2022	5.4	2.0	20.8	4.6
11/7/2022	9.1	2.0	37.1	4.6
11/14/2022	4.9	2.0	18.4	4.6
11/21/2022	6.4	2.0	28.1	4.6
11/28/2022	11.2	2.0	46.1	4.6
12/6/2022	6.0	2.0	34.1	4.6
12/13/2022	8.9	2.0	44.0	4.6
12/20/2022	5.6	2.0	20.9	4.6
12/27/2022	4.9	2.0	21.3	4.6

Table B.5 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Airport Road
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport Road				
1/3/2022	5.0	1.5	30.4	4.5
1/10/2022	4.2	1.5	37.6	4.5
1/18/2022	4.4	1.5	40.5	4.5
1/25/2022	4.4	1.5	30.2	4.5
1/31/2022	5.3	1.5	36.6	4.5
2/7/2022	4.1	1.5	21.0	4.5
2/14/2022	3.8	1.5	30.4	4.5
2/22/2022	3.6	1.5	25.1	4.5
3/1/2022	4.4	1.5	25.7	4.5
3/7/2022	5.7	1.5	42.3	4.5
3/14/2022	2.9	1.5	26.5	4.5
3/21/2022	<MDC	1.5	18.0	4.5
3/29/2022	2.0	1.5	13.2	4.5
4/4/2022	1.5	1.5	14.6	4.5
4/11/2022	3.2	1.5	12.6	4.5
4/18/2022	1.7	1.5	14.3	4.5
4/25/2022	3.2	1.5	21.3	4.5
5/3/2022	4.2	1.5	21.1	4.5
5/9/2022	<MDC	1.5	10.2	4.5
5/16/2022	4.5	1.5	22.7	4.5
5/31/2022	2.3	1.5	17.1	4.5
6/6/2022	2.6	1.5	19.0	4.5
6/13/2022	2.0	1.5	21.0	4.5
6/21/2022	4.5	1.5	21.2	4.5
6/27/2022	3.0	1.5	27.0	4.5

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport Road				
7/5/2022	2.6	1.5	20.3	4.5
7/11/2022	4.3	1.5	18.5	4.5
7/19/2022	3.6	1.5	28.4	4.5
7/26/2022	3.8	1.5	27.4	4.5
8/1/2022	3.7	1.5	19.1	4.5
8/9/2022	1.9	1.5	14.4	4.5
8/16/2022	2.9	1.5	27.7	4.5
8/23/2022	3.7	1.5	35.0	4.5
8/31/2022	7.9	1.5	32.1	4.5
9/6/2022	4.8	1.5	23.3	4.5
9/12/2022	2.7	1.5	28.9	4.5
9/19/2022	2.6	1.5	35.0	4.5
9/26/2022	6.0	1.5	25.7	4.5
10/3/2022	3.2	1.5	17.0	4.5
10/11/2022	4.7	1.5	32.2	4.5
10/24/2022	4.1	1.5	28.8	4.5
10/31/2022	6.3	1.5	20.2	4.5
11/7/2022	9.6	1.5	38.4	4.5
11/14/2022	4.3	1.5	19.3	4.5
11/21/2022	7.4	1.5	28.0	4.5
11/28/2022	9.1	1.5	47.1	4.5
12/6/2022	7.0	1.5	35.0	4.5
12/13/2022	9.7	1.5	45.1	4.5
12/20/2022	5.2	1.5	21.3	4.5
12/27/2022	4.6	1.5	27.1	4.5

Table B.6 Isotopic Uranium Sample Results for Soil Migration Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/16/2022	1.29	0.03	0.06	0.03	1.38	0.03
9/6/2022	1.27	0.03	0.08	0.03	1.26	0.03
Intersection of Gurley and Devers						
5/16/2022	1.14	0.03	0.03	0.03	1.23	0.03
9/6/2022	1.11	0.03	0.04	0.03	1.09	0.03
Massac Creek @ Country Club Rd						
5/16/2022	0.86	0.03	0.05	0.03	0.78	0.03
9/6/2022	0.34	0.03	<MDC	0.03	0.32	0.03
Nearest Residence						
5/16/2022	3.28	0.03	0.15	0.03	3.60	0.03
9/6/2022	2.67	0.03	0.13	0.03	2.84	0.03

Table B.7 Isotopic Uranium Sample Results for Soil Deposition Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/16/2022	1.30	0.05	0.12	0.07	1.44	0.06
9/6/2022	1.30	0.05	<MDC	0.07	1.29	0.06
Intersection of Gurley and Devers						
5/16/2022	1.14	0.05	<MDC	0.07	1.05	0.06
9/6/2022	0.98	0.05	<MDC	0.07	1.05	0.06
Massac Creek @ Country Club Rd						
5/16/2022	0.76	0.05	<MDC	0.07	0.84	0.06
9/6/2022	0.46	0.05	<MDC	0.07	0.59	0.06
Nearest Residence						
5/16/2022	3.42	0.05	0.14	0.07	3.54	0.06
9/6/2022	2.74	0.05	0.12	0.07	2.82	0.06

Table B.8 Ingrowth, Gamma Spectroscopy Sample Results for Soil Migration Samples
Results in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
Nearest Residence				
5/16/2022	1.23	0.02	1.54	1.52
9/6/2022	1.25	0.02	1.89	1.52

Table B.9 Ingrowth, Gamma Spectroscopy Sample Results for Soil Deposition Samples
Results in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
Nearest Residence				
5/16/2022	1.12	0.03	<MDC	6.60
9/6/2022	1.12	0.03	<MDC	6.60

Table B.10 Isotopic Uranium Sample Results for Sediment Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Ohio River At Joppa, 4 Mi. Dn S						
5/16/2022	0.71	0.04	0.05	0.04	0.78	0.02
9/6/2022	0.87	0.04	0.04	0.04	0.79	0.02
Public Boat Launch near Harrah's Casino						
5/16/2022	0.99	0.04	0.08	0.04	0.99	0.02
9/6/2022	0.62	0.04	<MDC	0.04	0.65	0.02

Table B.11 Isotopic Uranium Sample Results for Vegetation Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/16/2022	0.049	0.003	<MDC	0.003	0.052	0.003
9/6/2022	0.007	0.003	<MDC	0.003	0.005	0.003
Intersection of Gurley and Devers						
5/16/2022	0.006	0.003	<MDC	0.003	0.004	0.003
9/6/2022	0.008	0.003	<MDC	0.003	0.009	0.003
Massac Creek @ Country Club Rd						
5/16/2022	0.004	0.003	<MDC	0.003	<MDC	0.003
9/6/2022	0.004	0.003	<MDC	0.003	0.004	0.003
Nearest Residence						
5/16/2022	0.016	0.003	<MDC	0.003	0.014	0.003
9/6/2022	0.030	0.003	<MDC	0.003	0.026	0.003

Table B.12 Isotopic Uranium Sample Results for Water Samples
Results in picocuries per gram (pCi/L)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Massac Creek @ Country Club Rd						
3/1/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
5/16/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
11/28/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
Ohio River At Joppa, 4 Mi. DnS						
3/1/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
5/16/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
9/6/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
11/28/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
Public Boat Launch near Harrah's Casino						
3/1/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
5/16/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
9/6/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
11/28/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
PWS (Untreated)						
3/1/2022	0.5	0.3	<MDC	0.4	<MDC	0.3
5/16/2022	0.3	0.3	<MDC	0.4	<MDC	0.3
9/6/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3
11/28/2022	0.4	0.3	<MDC	0.4	<MDC	0.3
Small Creek in Fort Massac State Park						
11/28/2022	<MDC	0.3	<MDC	0.4	<MDC	0.3

Table B.13 Summary of Ambient Gamma Results

Location	Quarter 1 mR/quarter	Quarter 2 mR/quarter	Quarter 3 mR/quarter	Quarter 4 mR/quarter	Annual Exposure mR/year
METR-01	7.6	9.2	7.6	8.9	33.2
METR-02	7.6	8.4	6.5	5.1	27.5
METR-03	10.4	8.7	5.7	7.6	32.4
METR-04	6.5	8.8	6.6	7.9	29.8
METR-05	11.0	10.1	7.5	11.1	39.8
METR-06	10.6	11.3	9.0	7.7	38.6
METR-16	11.6	11.8	10.0	11.9	45.3
METR-20	6.6	8.6	8.2	7.6	31.1
METR-21	8.9	9.6	8.7	11.5	38.7
METR-22	9.2	9.9	8.4	8.7	36.1
METR-25	4.7	4.8	5.3	4.5	19.3
METR-26	7.6	10.1	9.7	10.9	38.2
METR-27	5.8	9.5	6.0	9.4	30.8
METR-28	8.1	11.1	7.2	8.6	35.0
METR-29	8.1	8.0	9.3	9.9	35.3
METR-30	9.4	11.9	10.1	11.8	43.1
METR-31	10.7	12.5	8.6	9.8	41.6
METR-32		12.6	11.4	12.5	48.6
METR-33	10.9	13.0	11.6	9.2	44.7

Blanks in the table indicate that the dosimeter was missing at the end of the quarter.
The Annual Dose column is based on averages of all available data.
Quarters estimated to be 91.25 days in length.

APPENDIX C
Sample Analysis Results for Samples Collected from Established Background Locations

Table C.1 Sample Results for Alpha / Beta Screening of Air Samples
Springfield Background Location
Results are in femtocuries per cubic meter (fCi/m^3)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Knotts Street Air Sampler				
1/4/2022	6.1	1.6	54.3	4.7
1/11/2022	4.2	1.6	37.1	4.7
1/18/2022	3.4	1.6	38.2	4.7
1/25/2022	1.6	1.6	26.7	4.7
2/1/2022	4.7	1.6	38.1	4.7
2/8/2022	4.9	1.6	42.8	4.7
2/15/2022	2.4	1.6	16.6	4.7
2/22/2022	2.5	1.6	26.2	4.7
3/2/2022	3.5	1.6	27.2	4.7
3/9/2022	3.0	1.6	21.9	4.7
3/15/2022	2.1	1.6	14.9	4.7
3/22/2022	2.5	1.6	20.5	4.7
3/29/2022	<MDC	1.6	8.1	4.7
4/5/2022	2.3	1.6	10.7	4.7
4/12/2022	1.9	1.6	5.7	4.7
4/19/2022	2.4	1.6	7.0	4.7
4/26/2022	1.9	1.6	11.7	4.7
5/4/2022	2.9	1.6	14.3	4.7
5/11/2022	3.0	1.6	13.7	4.7
5/17/2022	2.9	1.6	21.6	4.7
5/25/2022	<MDC	1.6	10.4	4.7
6/1/2022	2.0	1.6	15.2	4.7
6/8/2022	<MDC	1.6	17.6	4.7
6/14/2022	3.1	1.6	20.0	4.7
6/21/2022	<MDC	1.6	11.5	4.7
6/29/2022	3.5	1.6	16.9	4.7

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Knotts Street Air Sampler				
7/5/2022	2.0	1.6	11.8	4.7
7/13/2022	2.1	1.6	15.3	4.7
7/26/2022	<MDC	1.6	5.6	4.7
8/2/2022	2.0	1.6	16.3	4.7
8/9/2022	<MDC	1.6	9.5	4.7
8/18/2022	2.7	1.6	18.8	4.7
8/24/2022	<MDC	1.6	16.6	4.7
8/30/2022	5.5	1.6	22.5	4.7
9/6/2022	3.9	1.6	21.4	4.7
9/13/2022	2.0	1.6	24.8	4.7
9/20/2022	<MDC	1.6	13.5	4.7
9/28/2022	3.8	1.6	16.4	4.7
10/4/2022	2.1	1.6	12.2	4.7
10/11/2022	4.6	1.6	28.2	4.7
10/19/2022	1.6	1.6	8.7	4.7
10/25/2022	5.3	1.6	18.6	4.7
11/1/2022	6.2	1.6	19.7	4.7
11/9/2022	7.0	1.6	27.3	4.7
11/15/2022	<MDC	1.6	9.0	4.7
11/23/2022	7.6	1.6	27.8	4.7
11/29/2022	4.8	1.6	25.6	4.7
12/7/2022	6.0	1.6	28.9	4.7
12/13/2022	7.7	1.6	41.6	4.7
12/20/2022	4.6	1.6	15.2	4.7
12/27/2022	5.8	1.6	26.9	4.7

Table C.2 Sample Results for Alpha / Beta Screening of Air Samples
Marion Background Location
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Marion Office				
1/3/2022	4.8	1.5	36.8	4.5
1/10/2022	7.2	1.5	44.6	4.5
1/18/2022	3.9	1.5	41.9	4.5
1/25/2022	4.2	1.5	30.2	4.5
1/31/2022	7.2	1.5	35.8	4.5
2/7/2022	3.8	1.5	32.1	4.5
2/14/2022	4.0	1.5	28.6	4.5
2/22/2022	3.1	1.5	24.7	4.5
3/1/2022	4.1	1.5	25.6	4.5
3/7/2022	5.8	1.5	40.6	4.5
3/14/2022	3.1	1.5	28.2	4.5
3/21/2022	2.4	1.5	18.9	4.5
3/29/2022	2.1	1.5	15.2	4.5
4/4/2022	2.1	1.5	13.4	4.5
4/11/2022	2.7	1.5	13.4	4.5
4/18/2022	2.1	1.5	14.0	4.5
4/25/2022	2.8	1.5	17.3	4.5
5/3/2022	4.3	1.5	19.4	4.5
5/9/2022	<MDC	1.5	9.8	4.5
5/16/2022	4.1	1.5	23.8	4.5
5/24/2022	3.1	1.5	17.6	4.5
5/31/2022	2.8	1.5	15.4	4.5
6/6/2022	1.9	1.5	18.6	4.5
6/13/2022	2.3	1.5	20.5	4.5
6/21/2022	4.2	1.5	20.1	4.5

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Marion Office				
6/27/2022	2.2	1.5	19.5	4.5
7/5/2022	1.8	1.5	20.6	4.5
7/11/2022	2.5	1.5	17.5	4.5
7/19/2022	3.7	1.5	27.0	4.5
7/26/2022	4.1	1.5	27.5	4.5
8/1/2022	2.2	1.5	16.5	4.5
8/9/2022	<MDC	1.5	11.8	4.5
8/16/2022	2.8	1.5	28.0	4.5
8/23/2022	3.3	1.5	29.3	4.5
8/31/2022	6.7	1.5	31.7	4.5
9/6/2022	4.6	1.5	22.6	4.5
9/12/2022	2.2	1.5	26.4	4.5
9/19/2022	<MDC	1.5	34.3	4.5
9/26/2022	4.3	1.5	22.3	4.5
10/3/2022	2.9	1.5	15.5	4.5
10/11/2022	5.3	1.5	29.5	4.5
10/24/2022	3.6	1.5	27.2	4.5
10/31/2022	6.7	1.5	24.1	4.5
11/7/2022	9.3	1.5	40.8	4.5
11/14/2022	4.7	1.5	17.3	4.5
11/21/2022	6.1	1.5	24.9	4.5
11/28/2022	5.6	1.5	23.7	4.5
12/6/2022	5.5	1.5	33.3	4.5
12/13/2022	8.0	1.5	45.8	4.5
12/20/2022	6.4	1.5	21.1	4.5
12/27/2022	3.7	1.5	24.4	4.5

Table C.3 Sample Results for Alpha / Beta Screening of Air Samples
West Chicago Background Location
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
West Chicago				
1/12/2022	3.6	1.6	37.0	4.6
1/19/2022	3.7	1.6	37.5	4.6
1/26/2022	4.3	1.6	32.7	4.6
2/1/2022	2.7	1.6	36.4	4.6
2/8/2022	5.8	1.6	47.7	4.6
2/15/2022	3.4	1.6	24.3	4.6
2/22/2022	3.1	1.6	27.8	4.6
3/2/2022	3.4	1.6	33.3	4.6
3/8/2022	3.5	1.6	26.4	4.6
3/15/2022	3.0	1.6	26.4	4.6
3/22/2022	2.9	1.6	27.2	4.6
3/29/2022	<MDC	1.6	15.0	4.6
4/5/2022	2.7	1.6	10.5	4.6
4/12/2022	1.7	1.6	9.1	4.6
4/19/2022	<MDC	1.6	9.6	4.6
4/26/2022	2.6	1.6	7.1	4.6
5/3/2022	2.8	1.6	12.4	4.6
5/10/2022	3.3	1.6	11.8	4.6
5/16/2022	3.6	1.6	23.5	4.6
5/24/2022	2.5	1.6	10.5	4.6
5/31/2022	2.0	1.6	13.8	4.6
6/7/2022	2.2	1.6	15.6	4.6
6/13/2022	2.3	1.6	15.7	4.6
6/21/2022	2.8	1.6	20.2	4.6

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
West Chicago				
6/28/2022	2.7	1.6	17.4	4.6
7/5/2022	3.8	1.6	22.4	4.6
7/11/2022	3.5	1.6	17.9	4.6
7/25/2022	3.9	1.6	21.3	4.6
8/2/2022	2.2	1.6	17.5	4.6
8/8/2022	2.4	1.6	16.8	4.6
8/16/2022	2.0	1.6	16.9	4.6
8/23/2022	1.9	1.6	26.9	4.6
8/29/2022	6.3	1.6	27.1	4.6
9/6/2022	3.8	1.6	20.8	4.6
9/13/2022	3.9	1.6	23.2	4.6
9/20/2022	7.5	1.6	29.0	4.6
9/27/2022	3.0	1.6	17.6	4.6
10/4/2022	2.2	1.6	12.1	4.6
10/11/2022	8.9	1.6	26.1	4.6
10/19/2022	5.6	1.6	16.0	4.6
10/25/2022	7.1	1.6	37.3	4.6
11/9/2022	4.5	1.6	31.4	4.6
11/18/2022	2.2	1.6	17.0	4.6
11/22/2022	8.2	1.6	40.9	4.6
11/29/2022	8.3	1.6	53.8	4.6
12/7/2022	6.6	1.6	38.4	4.6
12/13/2022	5.5	1.6	30.7	4.6
12/20/2022	3.4	1.6	23.9	4.6

Table C.4 Isotopic Uranium Sample Results for Soil Migration Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
East Boat Dock						
5/27/2022	1.08	0.01	0.03	0.01	1.13	0.01
9/14/2022	0.96	0.01	0.03	0.01	1.00	0.01
Strawkaws Boat Ramp						
5/27/2022	1.03	0.01	0.04	0.01	1.01	0.01
9/14/2022	0.99	0.01	0.04	0.01	1.08	0.01
West Boat Ramp						
5/27/2022	1.13	0.01	0.06	0.01	1.23	0.01
9/14/2022	0.94	0.01	0.05	0.01	1.12	0.01

Table C.5 Isotopic Uranium Sample Results for Soil Deposition Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
East Boat Dock						
5/27/2022	1.00	0.02	0.06	0.02	1.01	0.01
9/14/2022	0.93	0.02	0.05	0.02	0.98	0.01
Strawkaws Boat Ramp						
5/27/2022	1.00	0.02	0.05	0.02	0.98	0.01
9/14/2022	0.90	0.02	0.05	0.02	1.01	0.01
West Boat Ramp						
5/27/2022	1.01	0.02	0.08	0.02	1.18	0.01
9/14/2022	0.98	0.02	0.06	0.02	1.05	0.01

Table C.6 Ingrowth, Gamma Spectroscopy Sample Results for Soil Migration Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
West Boat Ramp				
5/27/2022	1.27	0.02	2.10	1.49
9/14/2022	1.06	0.02	1.70	1.49

Table C.7 Ingrowth, Gamma Spectroscopy Sample Results for Soil Deposition Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
West Boat Ramp				
5/27/2022	1.22	0.02	<MDC	3.70
9/14/2022	1.01	0.02	<MDC	3.70

Table C.8 Isotopic Uranium Sample Results for Sediment Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Strawkaws Boat Ramp						
5/27/2022	0.14	0.02	<MDC	0.01	0.16	0.01
9/14/2022	0.19	0.02	<MDC	0.01	0.18	0.01
West Boat Ramp						
5/27/2022	0.59	0.02	0.04	0.01	0.70	0.01
9/14/2022	0.59	0.02	0.04	0.01	0.66	0.01

Table C.9 Isotopic Uranium Sample Results for Vegetation Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
East Boat Dock						
5/27/2022	0.007	0.005	<MDC	0.003	0.004	0.003
9/14/2022	<MDC	0.005	<MDC	0.003	0.008	0.003
Strawkaws Boat Ramp						
5/27/2022	0.006	0.005	<MDC	0.003	0.005	0.003
9/14/2022	<MDC	0.005	<MDC	0.003	0.005	0.003
West Boat Ramp						
5/27/2022	0.005	0.005	<MDC	0.003	0.008	0.003
9/14/2022	0.005	0.005	<MDC	0.003	0.004	0.003

Table C.10 Isotpic Uranium Sample Results for Water Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/L)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
East Boat Dock						
3/8/2022	<MDC	0.3	<MDC	0.3	0.3	0.2
5/27/2022	0.3	0.3	<MDC	0.3	0.3	0.2
9/14/2022	<MDC	0.3	<MDC	0.3	0.2	0.2
11/30/2022	<MDC	0.3	<MDC	0.3	0.3	0.2
Strawkaws Boat Ramp						
3/8/2022	0.3	0.3	<MDC	0.3	0.3	0.2
5/27/2022	0.4	0.3	<MDC	0.3	0.3	0.2
9/14/2022	0.5	0.3	<MDC	0.3	<MDC	0.2
11/30/2022	0.3	0.3	<MDC	0.3	0.3	0.2
West Boat Ramp						
3/8/2022	0.3	0.3	<MDC	0.3	0.4	0.2
5/27/2022	0.3	0.3	<MDC	0.3	0.3	0.2
9/14/2022	<MDC	0.3	<MDC	0.3	0.2	0.2
11/30/2022	0.5	0.3	<MDC	0.3	0.4	0.2

Table C.11 Summary of Ambient Gamma Results
Kincaid, Illinois Background Locations

Location	Quarter 1 mR/quarter	Quarter 2 mR/quarter	Quarter 3 mR/quarter	Quarter 4 mR/quarter	Annual exposure mR/year
KC-01	12.8	9.2	10.7	8.3	41.1
KC-02	12.7		8.4	8.3	39.2
KC-03	8.6	9.5	7.7	10.1	35.9
KC-04	9.6	8.4	11.6	11.8	41.5
KC-05	10.1	7.2	11.8	11.2	40.4
KC-06	9.3	6.0	11.3	8.9	35.4
KC-07			11.5	11.3	45.7
KC-08		8.4	9.3	10.3	37.4
KC-09	8.3	7.7	8.9	9.1	34.0
KC-10		7.6	12.2	10.8	40.8
KC-11	11.9	11.5	11.4	10.8	45.6
KC-12	11.3	10.6	11.4	9.7	43.1
KC-13	8.6	8.2	12.0		38.4
KC-14	10.7	10.6	10.0	8.5	39.8
KC-15	10.6	7.0	9.3	9.1	36.0

Blanks in the table indicate that the dosimeter was missing at the end of the quarter.
The Annual Dose column is based on averages of all available data.
Quarters estimated to be 91.25 days in length.

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