Department of Environmental Quality
INL Oversight Program

# ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

**July - September, 2022**


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# Table of Acronyms

| | | |
|---|---|---|
| aCi/L | - | attocuries per liter |
| ATR | - | Advanced Test Reactor |
| BEA | - | Battelle Energy Alliance, LLC |
| BLR | - | Big Lost River |
| CERCLA | - | Comprehensive Environmental Response, Compensation and Liability Act |
| CFA | - | Central Facilities Area |
| CFR | - | Code of Federal Regulations |
| CITRC | - | Critical Infrastructure Test Range Complex |
| DEQ-INL OP | - | The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program |
| DOE | - | U.S. Department of Energy |
| EBR I & II | - | Experimental Breeder Reactors I & II |
| EFS | - | Experimental Field Station |
| EIC | - | electret ionization chamber |
| EML | - | Environmental Monitoring Laboratory |
| EPA | - | Environmental Protection Agency |
| ESER | - | Environmental Surveillance, Education and Research Program |
| ESP | - | Environmental Surveillance Program |
| ESRP | - | Eastern Snake River Plain |
| ESRPA | - | Eastern Snake River Plain Aquifer |
| Ft bls | | feet below land surface |
| HPIC | - | high-pressure ion chamber |
| IBL | - | Idaho Bureau of Laboratories |
| ICPP | - | Idaho Chemical Processing Plant |
| ICP | - | Idaho Cleanup Project |
| ISB | - | In-situ bioremediation |
| IDL | - | instrument detection limit |
| INL | - | Idaho National Laboratory |
| INTEC | - | Idaho Nuclear Technology and Engineering Center |
| ISU | - | Idaho State University |
| LLD | - | lower limit of detection |
| LSC | - | liquid scintillation counting |
| MCL | - | maximum contaminant level |
| MDA | - | minimum detectable activity |
| MDC | - | minimum detectable concentration |
| MFC | - | Materials and Fuels Complex |
| µg/L | - | micrograms per liter |
| mg/L | - | milligrams per liter |
| MP | - | milepost |
| mrem | - | millirem or 1/1000$^{th}$ of a rem |
| mR | - | milliRoentgen |
| mR/hr | - | milliRoentgen per hour |
| µR/hr | - | microRoentgen per hour |
| MV | - | Magic Valley |
| NIST | - | National Institute of Standards and Technology |
| nCi/L | - | nanocuries per liter |
| NCRP | - | National Council on Radiation Protection and Measurements |
| NOAA | - | National Oceanic and Atmospheric Administration |
| NRF | - | Naval Reactors Facility |
| PBF | - | Power Burst Facility |
| pCi/g | - | picocuries per gram |
| pCi/L | - | picocuries per liter |
| pCi/m$^3$ | - | picocuries per cubic meter |
| QAPP | - | Quality Assurance Program Plan |
| QA/QC | - | Quality Assurance/Quality Control |
| RCRA | - | Resource Conservation and Recovery Act |
| RPD | - | relative percent difference |
| RTC | - | Reactor Technology Complex |
| RWMC | - | Radioactive Waste Management Complex |
| SD | - | Sample standard deviation |
| SMC | - | Specific Manufacturing Capability |
| SMCL | - | secondary maximum contaminant level |
| TAN | - | Test Area North |
| TDS | - | total dissolved solids |
| TMI | - | Three Mile Island |
| TRA | - | Test Reactor Area |
| TSP | - | total suspended particulate |
| TSS | - | total suspended solids |
| USGS | - | U.S. Geological Survey |
| VOC | - | volatile organic compound |
| WLAP | - | Wastewater Land Application Permit |

# Introduction

The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program (DEQ-INL OP) conducts an Environmental Surveillance Program (ESP) at locations on the INL, near the boundaries of the INL, and at distant locations to the INL in accordance with accepted monitoring procedures and management practices. This program is designed to provide the people of the state of Idaho with independently evaluated information about the impacts of the Department of Energy's (DOE) activities in Idaho.

The primary objective for DEQ-INL OP's ESP is to maintain an independent environmental monitoring and verification program designed to verify and supplement DOE's environmental data and programs. This program also provides the citizens of Idaho with information on current and proposed DOE programs that has been independently evaluated to enable them to reach informed conclusions about DOE activities in Idaho and potential impacts to public health and the environment.

Results of the ESP are published using two distinct reporting formats: quarterly data reports and an annual ESP report. The annual ESP report is designed for a broad audience and summarizes the results of the ESP for the previous four quarters. The annual report's primary emphasis is to focus on trends, ascertain the impacts of DOE operations on the environment, and confirm the validity of DOE monitoring programs. This quarterly report is designed to document the results of the ESP on a quarterly basis and provide detailed data. It is organized according to the media sampled and also provides a quality assurance assessment.

# Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the third quarter, 2022 (**Figure 1**). These stations employed instrumentation for collecting airborne particulate matter, gaseous radioiodine, precipitation, and water vapor for tritium analysis (**Table 1**). The Shoshone-Bannock Tribes operated an air monitoring station located at Fort Hall. The Fort Hall station uses identical instrumentation and sampling protocol as the ten stations operated by the ESP. The DEQ-INL OP reports the Fort Hall station data as an additional distant site.

Airborne particulate matter was sampled using both high-volume (8x10-inch filter) and low-volume (47-mm filter) total suspended particulate (TSP) air samplers. Many of these air samplers were found to be operating outside of their expected flow rate range in the third quarter, 2022. A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of these samplers. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements and have been footnoted as estimates. Weekly gross alpha and gross beta particulate radioactivity results for 47-mm filters from the low-volume TSP samplers are presented in **Appendix A** and summarized as a range of results in **Table 2**. Results are within the expected historical range.

Composites of 47-mm filters collected from low-volume TSP samplers during a calendar quarter are analyzed using gamma spectrometry. Composites of 8x10-inch filters collected from high-volume TSP samplers during each calendar month are also analyzed using gamma spectrometry. Typically, gamma spectrometry results are only reported when exceeding a minimum detectable concentration (MDC). Gamma spectrometry results for the third quarter of 2022 for 47-mm and 8x10-inch TSP filters are presented in **Tables 3** and **4**. The September monthly 8x10-inch filter composite from the Experimental Field Station (EFS) produced a greater-than-MDC Cs-137 air concentration value of $(0.20 \pm 0.10) \times 10^{-3}$ $pCi/m^3$. The quarterly EFS 47-mm filter composite produced a less-than MDC Cs-137 result. For both filter sizes, the only other reported gamma-emitting radionuclide >MDC was beryllium-7 (Be-7), a

naturally occurring, cosmogenic radionuclide. The MDC for cesium-137 (Cs-137) is also reported for all locations since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

Beginning in first quarter 2022, quarterly composites of 8x10-inch filters collected using high-volume TSP samplers are analyzed using radiochemical separation techniques. Results from the quarterly 8x10-inch filter composite analyses are typically presented in the following quarter's report. The samples are analyzed for Strontium-90, Plutonium-238, Plutonium-239/240, and Americium-241. Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons, and possibly from INL programs. DEQ-INL OP's action levels of 19 for Americium-241 (Am-241), 190 for Strontium-90 (Sr-90), 21 for Plutonium-238 (Pu-238), and 20 for Plutonium-239/240 (Pu-239/240) (in 1 x $10^{-5}$ pCi/$m^3$) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation.

Radiochemical separation analysis results for 8x10-inch TSP particulate filters collected during second quarter 2022 are presented in **Table 5.** Strontium-90 (Sr-90) results were greater than MDC at the on-site location Van Buren Avenue [(4.36 ± 2.11) x $10^{-5}$ pCi/$m^3$] and the boundary location Atomic City [(4.72 ± 2.12) x $10^{-5}$ pCi/$m^3$]. The blank sample Sr-90 analysis result for this batch of samples exceeded the MDC, and a recounted blank sample result also exceeded the MDC. The greater-than-MDC field sample Sr-90 results are qualified as biased-high estimates (J+) and the less-than-MDC field sample results are qualified as non-detected estimates (UJ). The field sample Sr-90 results are well below the DEQ-INL OP action level. There are no greater-than-MDC results for Pu-238, Pu-239/240, or Am-241 for the second quarter of 2022.

Radioactive iodine samples are collected weekly. Samples are collected by drawing air through a canister filled with activated charcoal using a low-volume air pump. The activated charcoal contained in the canister traps the radioiodine by adsorption onto its porous surface. Each week, canisters are collected from all eleven air monitoring stations and analyzed together as a composite using gamma spectrometry (**Table 6**). If Iodine-131 is detected in this grouping, the canisters are individually analyzed. No radioactive isotopes of iodine, specifically Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the third quarter of 2022.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. Atmospheric tritium concentrations and their weighted quarterly means are presented in **Table 7**.

The on-site Big Lost River Rest Area atmospheric tritium concentration was > (greater than) MDC for the individual sample for the time period 8/18 – 9/01/22. The Experimental Field Station (EFS) individual sample concentrations were > MDC for the periods 8/25 – 9/22/22 and 9/22 – 9/28/22, equal to the MDC for the period 6/29 – 8/11/22, and essentially equal to the MDC and >3s for the period 8/11 – 8/25/22. The EFS weighted mean tritium concentration was also greater than the weighted mean MDC. These on-site location > MDC results strongly suggest an INL source.

The boundary locations Atomic City and Howe individual sample atmospheric tritium concentrations were > MDC for the time period 9/14 – 9/28/22. The Monteview concentration was > MDC for the period 7/28 – 8/10/22. These boundary location > MDC results may suggest an INL source. The distant location Fort Hall individual sample concentration was > MDC for the period 9/7 – 9/28/22. All results are well below the DEQ-INL OP action level of 150 pCi/$m^3$ (40 CFR 61).

Precipitation samples were collected at six monitoring locations during the third quarter of 2022. Precipitation samples were analyzed for tritium and man-made gamma emitting radionuclides. Reported values were either the result of a single sample or a weighted mean when more than one precipitation sample was collected during the calendar quarter. Tritium and man-made gamma emitting radionuclides were below minimum detectable concentration in precipitation collected during the third quarter of 2022. Analysis results for Tritium (H-3) and Cesium-137, the most likely to be detected of man-made gamma emitting radionuclides, are presented in **Table 8**.

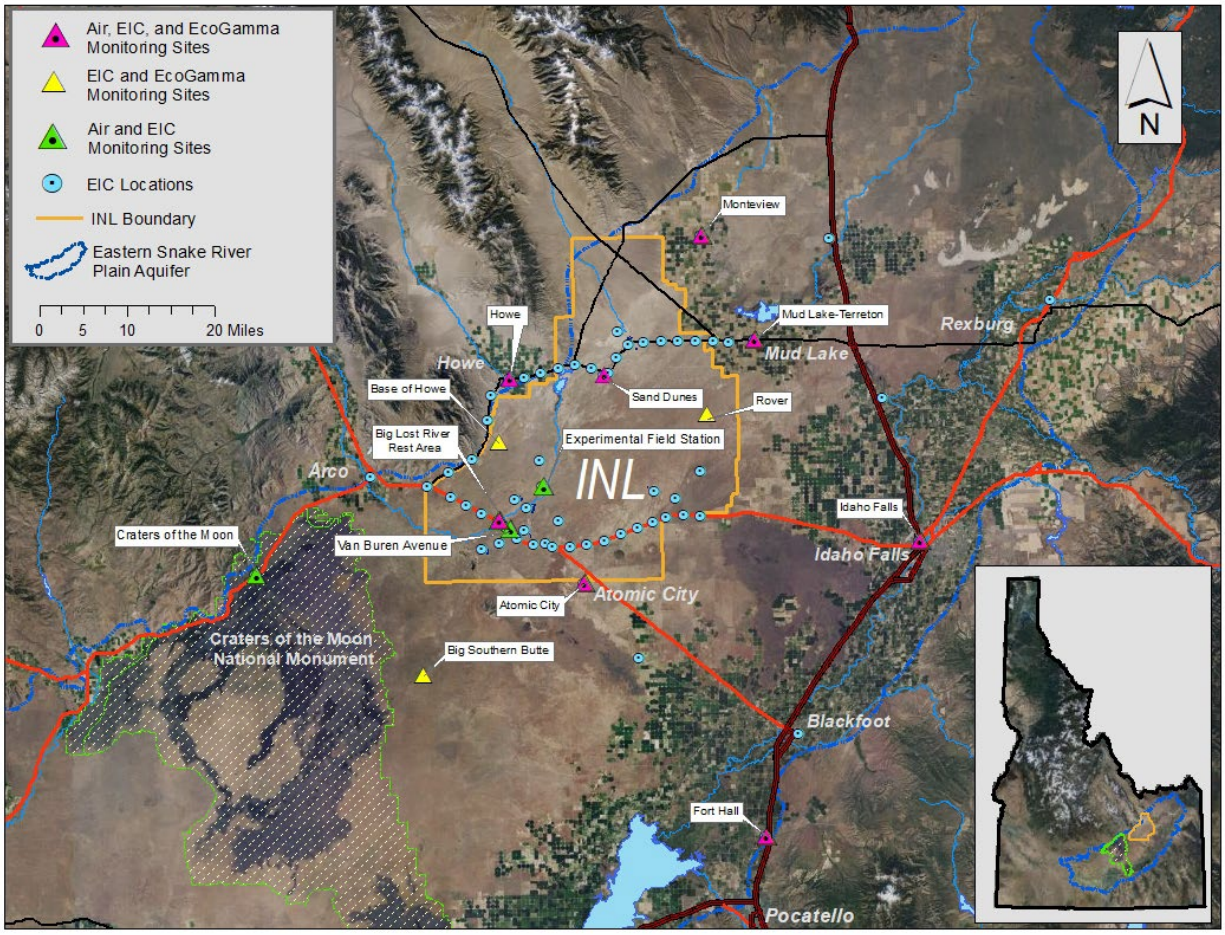


**Figure 1. Air and radiation monitoring locations.**

**Table 1. Sampling locations and sample type**

| Station Locations | Sample type[1] | | | |
|---|---|---|---|---|
| | TSP | Radioiodine | Water Vapor | Precipitation |
| **On-site Locations** | | | | |
| Big Lost River Rest Area | □ | □ | ■ | ■ |
| Experimental Field Station | □ | □ | ■ | |
| Sand Dunes Tower | □ | □ | ■ | |
| Van Buren Avenue | □ | □ | ■ | |
| **Boundary Locations** | | | | |
| Atomic City | □ | □ | ■ | ■ |
| Howe | □ | □ | ■ | ■ |
| Monteview | □ | □ | ■ | ■ |
| Mud Lake | □ | □ | ■ | ■ |
| **Distant Locations** | | | | |
| Craters of the Moon | □ | □ | ■ | |
| Fort Hall[2] | □ | □ | ■ | |
| Idaho Falls | □ | □ | ■ | ■ |

[1] □Samples collected weekly; ■ Samples collected quarterly.
[2]TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

**Table 2. Range of gross alpha and gross beta concentrations for TSP filters, third quarter, 2022.**

| Station Location | Concentration | | | | | |
|---|---|---|---|---|---|---|
| | Gross Alpha | | | Gross Beta | | |
| **On-Site Locations** | | | | | | |
| Big Lost River Rest Area | 0.5 | - | 2.9 | 25.1 | - | 33.6 |
| Experimental Field Station | 0.5 | - | 4.5 J[2] | 21.4 | - | 38.8 J[2] |
| Sand Dunes Tower | 0.8 | - | 3.0 | 23.9 | - | 36.7 |
| Van Buren Avenue | 0.2 | - | 3.7 | 10.7 | - | 42.4 |
| **Boundary Locations** | | | | | | |
| Atomic City | 0.9 | - | 3.5 | 23.8 | - | 36.5 |
| Howe | 0.5 J[3] | - | 3.8 | 24.0 J[3] | - | 37.0 J[3] |
| Monteview | 0.6 | - | 3.6 | 22.5 | - | 34.8 J[2] |
| Mud Lake | 0.4 | - | 2.3 | 22.5 J[3] | - | 36.9 |
| **Distant Locations** | | | | | | |
| Craters of the Moon | 0.5 | - | 3.7 | 23.4 J[3] | - | 36.0 |
| Fort Hall[1] | 0.2 J[4] | - | 2.5 J[4] | 1.9 J[4] | - | 32.0 J[4] |
| Idaho Falls | 0.2 | - | 2.5 | 22.1 J[3] | - | 35.8 |

Note: Concentrations are expressed in 1 x $10^{-3}$ pCi/$m^3$.

[1]Operated by Shoshone-Bannock Tribes.
[2]Partial sample. Results are J-flagged as (usable) estimates.
[3]Estimated volume. Results are J-flagged as (usable) estimates.
[4]Improper sampling orientation with the filter not fully exposed to the ambient air. Results are considered (usable) estimates.

**Table 3. Gamma spectrometry analysis data for 47-mm TSP filters, quarterly composite samples, third quarter, 2023.**

| Station Location | Naturally Occurring Radionuclide Beryllium-7 | | | Man-Made Gamma Emitting Radionuclides | | |
|---|---|---|---|---|---|---|
| | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC[2] |
| **On-site Locations** | | | | | | |
| Big Lost River Rest Area | 100.5 | 6.2 | 2.0 | 0.04 | 0.08 | 0.13 |
| Experimental Field Station | 122.7 J[3] | 7.6 J[3] | 1.8 J[3] | 0.05 J[3] | 0.08 J[3] | 0.14 J[3] |
| Sand Dunes Tower | 131.0 | 8.1 | 2.8 | 0.03 | 0.09 | 0.15 |
| Van Buren Avenue | 134.5 | 8.0 | 2.0 | 0.03 | 0.10 | 0.16 |
| **Boundary Locations** | | | | | | |
| Atomic City | 126.1 | 7.6 | 1.4 | 0.01 | 0.06 | 0.10 |
| Howe | 133.3 J[3] | 8.2 J[3] | 2.4 J[3] | 0.01 J[3] | 0.09 J[3] | 0.15 J[3] |
| Monteview | 121.6 J[3] | 7.4 J[3] | 2.4 J[3] | 0.10 J[3] | 0.13 J[3] | 0.22 J[3] |
| Mud Lake | 127.6 J[3] | 7.8 J[3] | 1.6 J[3] | 0.03 J[3] | 0.09 J[3] | 0.15 J[3] |
| **Distant Locations** | | | | | | |
| Craters of the Moon | 132.9 J[3] | 8.1 J[3] | 2.4 J[3] | 0.01 J[3] | 0.09 J[3] | 0.15 J[3] |
| Fort Hall[1] | 86.9 J-[4] | 5.7 J-[4] | 2.8 J-[4] | 0.03 J-[4] | 0.16 J-[4] | 0.26 J-[4] |
| Idaho Falls | 134.5 J[3] | 8.0 J[3] | 1.8 J[3] | 0.03 J[3] | 0.08 J[3] | 0.14 J[3] |

Note: Concentrations are reported in 1 x $10^{-3}$ pCi/$m^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.
[3]Air volume was estimated in at least one weekly TSP sample for all locations. Results are J-flagged as estimates.
[4] Improper sampling orientation with the filter not fully exposed to the ambient air. A dust/dirt clog was discovered 9/6/2022 on the wire screen of the intake tube. Particulates were not allowed to freely flow to the filter. Results are considered usable biased-low estimates (flagged J-).

**Table 4. Gamma spectrometry analysis data for 8x10-inch TSP filters, monthly composite samples, third quarter, 2022.**

| Station Location | Month[4] | Naturally Occurring Radionuclide Beryllium-7 | | | Man-Made Gamma Emitting Radionuclides | | |
|---|---|---|---|---|---|---|---|
| | | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC[2] |
| **On-site Locations** | | | | | | | |
| Big Lost River Rest Area | July | 199.6 | 11.2 | 0.8 | 0.05[6] | 0.03 | 0.05[6] |
| | Aug | 136.2 | 7.8 | 0.9 | 0.03 | 0.05 | 0.10 |
| | Sept | 175.5 | 10.2 | 1.8 | 0.02 | 0.06 | 0.10 |
| Experimental Field Station | July | 163.9 | 9.2 | 0.7 | 0.04 | 0.03 | 0.05 |
| | Aug | 139.3 | 8.0 | 0.9 | 0.06 | 0.05 | 0.09 |
| | Sept[5] | 177.0 | 10.3 | 1.7 | 0.20 | 0.10 | 0.16 |
| Sand Dunes Tower | July | 167.1 | 9.6 | 1.2 | 0.04 | 0.04 | 0.06 |
| | Aug | 123.5 | 7.1 | 1.2 | 0.05 | 0.06 | 0.09 |
| | Sept | 149.1 | 8.7 | 2.0 | 0.06 | 0.06 | 0.10 |
| Van Buren Avenue | July | 157.6 | 9.0 | 1.1 | 0.01 | 0.03 | 0.06 |
| | Aug | 135.9 | 7.8 | 1.2 | 0.08 | 0.06 | 0.09 |
| | Sept | 160.6 | 9.4 | 1.5 | 0.01 | 0.05 | 0.09 |
| **Boundary Locations** | | | | | | | |
| Atomic City | July | 190.7 | 10.7 | 0.8 | 0.01 | 0.04 | 0.07 |
| | Aug | 142.4 | 8.2 | 1.4 | 0.01 | 0.04 | 0.07 |
| | Sept | 226.5 | 12.8 | 1,1 | 0.02 | 0.05 | 0.09 |
| Howe | July | 167.4 | 9.6 | 1.1 | 0.02 | 0.04 | 0.06 |
| | Aug | 118.2 | 6.9 | 0.8 | 0.00 | 0.07 | 0.11 |
| | Sept | 126.1 | 7.5 | 1.8 | 0.02 | 0.06 | 0.09 |
| Monteview | July | 195.9 | 11.0 | 0.8 | 0.02 | 0.04 | 0.07 |
| | Aug | 150.2 | 8.9 | 2.0 | 0.04 | 0.05 | 0.09 |
| | Sept | 181.7 | 10.5 | 1.2 | 0.04 | 0.05 | 0.08 |
| Mud Lake | July | 174.4 | 9.9 | 0.7 | 0.01 | 0.04 | 0.07 |
| | Aug | 124.1 | 7.3 | 1.4 | 0.05 | 0.04 | 0.07 |
| | Sept | 164.7 | 9.6 | 1.1 | 0.01 | 0.05 | 0.09 |
| **Distant Locations** | | | | | | | |
| Craters of the Moon | July | 230.5 | 13.1 | 0.8 | 0.02 | 0.06 | 0.09 |
| | Aug | 148.4 | 8.6 | 1.4 | -0.02 | 0.06 | 0.10 |
| | Sept | 174.0 | 10.1 | 1.1 | 0.02 | 0.05 | 0.09 |
| Fort Hall[1] | July | 174.7 | 9.9 | 0.8 | -0.01 | 0.04 | 0.07 |
| | Aug | 150.2 | 8.7 | 1.6 | -0.01 | 0.06 | 0.10 |
| | Sept | 212.9 | 12.1 | 1.4 | 0.05 | 0.05 | 0.08 |
| Idaho Falls | July | 189.7 | 10.7 | 1.0 | 0.01 | 0.03 | 0.05 |
| | Aug | 130.0 | 7.6 | 1.5 | 0.00 | 0.06 | 0.10 |
| | Sept | 177.3 | 10.3 | 1.7 | 0.01 | 0.05 | 0.09 |
| Idaho Falls Duplicate[3] | July | 193.5 | 11.0 | 1.1 | 0.02 | 0.03 | 0.05 |
| | Aug | 162.4 | 9.3 | 1.1 | 0.04 | 0.04 | 0.07 |
| | Sept | 207.7 | 11.8 | 1.2 | 0.02 | 0.05 | 0.09 |

Note: Concentrations are reported in 1 x $10^{-3}$ pCi/$m^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.
[3]A duplicate 8x10-inch filter TSP sampler is currently being operated at the Idaho Falls location.
[4]Four filters /composite for July and September. Five filters/composite for August.
[5]Three filters/composite for September at Experimental Field Station.
[6]All values are rounded. Unrounded concentration is less than MDC.

**Table 5. Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during first quarter 2022.**

| Station Location | $^{90}Sr$ | | | $^{238}Pu$ | | | $^{239/240}Pu$ | | | $^{241}Am$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value[1,8] | ±2SD | MDC | Value[1] | ± 2SD | MDC | Value[1] | ±2SD | MDC | Value[1] | ±2SD | MDC |
| **On-Site Locations** | | | | | | | | | | | | |
| BLR[4] Rest Area | -0.07 UJ | 1.21 | 2.26 | -0.16 | 0.14 | 0.34 | 0.05 | 0.08 | 0.12 | 0.03 | 0.13 | 0.21 |
| EFS[3] | 0.21 UJ | 1.26 | 2.31 | 0.09 | 0.15 | 0.25 | 0.09 | 0.17 | 0.29 | -0.05 | 0.10 | 0.31 |
| Sand Dunes | 1.26 UJ | 1.38 | 2.25 | -0.16 | 0.14 | 0.34 | 0.03 | 0.12 | 0.23 | 0.08 | 0.15 | 0.21 |
| Van Buren | 4.63 J+ | 2.11 | 2.28 | 0.02 | 0.07 | 0.13 | 0.13 | 0.12 | 0.16 | 0.04 | 0.17 | 0.33 |
| **Boundary Locations** | | | | | | | | | | | | |
| Atomic City | 4.72 J+ | 2.12 | 2.29 | -0.06 | 0.11 | 0.27 | 0.07 | 0.12 | 0.20 | -0.05 | 0.11 | 0.34 |
| Howe | 1.79 UJ | 1.62 | 2.55 | 0.05 | 0.08 | 0.12 | 0.12 | 0.12 | 0.14 | 0.15 | 0.18 | 0.19 |
| Monteview | 2.31 UJ | 1.61 | 2.32 | 0.02 | 0.06 | 0.09 | 0.07 | 0.09 | 0.14 | -0.03 | 0.08 | 0.23 |
| Mud Lake | 1.47 UJ | 1.43 | 2.28 | 0.03 | 0.12 | 0.24 | 0.03 | 0.15 | 0.30 | 0.01 | 0.13 | 0.26 |
| **Distant Locations** | | | | | | | | | | | | |
| Craters of the Moon | 1.05 UJ | 1.40 | 2.34 | 0.02 | 0.07 | 0.14 | -0.02 | 0.09 | 0.21 | -0.03 | 0.15 | 0.35 |
| Fort Hall[2] | 0.15 UJ | 1.28 | 2.33 | 0.02 | 0.14 | 0.28 | -0.04 | 0.13 | 0.29 | 0.07 | 0.15 | 0.25 |
| Idaho Falls | 1.04 UJ | 1.41 | 2.36 | 0.08 | 0.10 | 0.13 | 0.06 | 0.10 | 0.17 | 0.02 | 0.14 | 0.26 |
| Idaho Falls Dup[5] | 0.18 UJ | 1.20 | 2.26 | 0.08 | 0.09 | 0.12 | 0.00 | 0.07 | 0.15 | 0.03 | 0.13 | 0.21 |

Note: Concentrations are reported in 1 x $10^{-5}$ pCi/$m^3$ with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar quarter.

[1]Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons, and possibly from INL programs. DEQ-INL OP's action levels of 19 for americium-241, 190 for strontium-90, 21 for plutonium-238, and 20 for plutonium-239/240 (in 1 x $10^{-5}$ pCi/$m^3$) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.
[2] Operated by Shoshone-Bannock Tribes.
[3] EFS - Experimental Field Station.
[4]BLR – Big Lost River.
[5]Dup – Duplicate TSP sampler being run at the Idaho Falls location.
[6] Blank sample Sr-90 analysis result for this batch of samples exceeded the MDC, and a recounted sample result also exceeded the MDC. The greater than MDC field sample results are qualified as biased-high estimates (J+). The less-than-MDC field sample results are qualified as non-detected estimates (UJ).

**Table 6. Iodine-131 activity in weekly charcoal filter composites, third quarter, 2022.**

| Start Date | Collection Date | Iodine-131 activity (pCi/composite) | | |
|---|---|---|---|---|
| | | Activity | ± 2 SD | MDA[1] |
| 06/29/22 | 07/06/22 | -0.13 | 1.14 | 1.99 |
| 07/06/22 | 07/13/22 | -0.24 | 2.29 | 3.88 |
| 07/13/22 | 07/20/22 | 0.23 | 1.51 | 2.57 |
| 07/20/22 | 07/27/22 | -0.60 | 1.11 | 1.99 |
| 07/27/22 | 08/03/22 | -0.38 | 1.09 | 1.93 |
| 08/03/22 | 08/10/22 | 0.48 | 1.78 | 3.00 |
| 08/10/22 | 08/17/22 | 0.05 | 1.80 | 3.07 |
| 08/17/22 | 08/24/22 | 0.49 | 1.38 | 2.34 |
| 08/24/22 | 08/31/22 | 0.85 | 3.19 | 5.32 |
| 08/31/22 | 09/07/22 | 1.41 | 2.31 | 3.83 |
| 09/07/22 | 09/14/22 | 0.63 | 1.54 | 2.59 |
| 09/14/22 | 09/21/22 | 0.50 | 2.12 | 3.57 |
| 09/21/22 | 09/28/22 | 0.25 | 1.68 | 2.85 |

[1]The minimum detectable activity (MDA) is established for the least efficient counting position in the eleven-cartridge composite. Based on a typical 20,000 $ft^3$ (566 $m^3$) air volume per cartridge, and eleven cartridges per composite, the highest I-131 MDA of 5.32 pCi/composite is equivalent to a maximum MDC of 8.5 $x10^{-4}$ $pCi/m^3$.

**Table 7. Tritium concentrations in air from atmospheric moisture, third quarter, 2022.**

| Station Location | Start Date | Collection Date | Tritium | | |
|---|---|---|---|---|---|
| | | | Concentration | ± 2 SD | MDC |
| **On-site Locations** | | | | | |
| Big Lost River Rest Area | 6/29/2022 | 8/03/2022 | 0.28 | 0.45 | 0.74 |
| Big Lost River Rest Area | 8/03/2022 | 8/18/2022 | 0.61 | 0.79 | 1.31 |
| Big Lost River Rest Area | 8/18/2022 | 9/01/2022 | 1.09 | 0.68 | 1.06 |
| Big Lost River Rest Area | 9/01/2022 | 9/28/2022 | 0.64 | 0.69 | 1.13 |
| **Big Lost River Rest Area Mean** | **6/29/2022** | **9/28/2022** | **0.57** | **0.60** | **0.97** |
| | | | | | |
| Experimental Field Station | 6/29/2022 | 8/11/2022 | 0.70 | 0.44 | 0.70 |
| Experimental Field Station | 8/11/2022 | 8/25/2022 | 1.41 J[2] | 0.90 J | 1.42 J |
| Experimental Field Station | 8/25/2022 | 9/07/2022 | 1.81 J[1] | 0.51 J | 0.71 J |
| Experimental Field Station | 9/22/2022[4] | 9/28/2022 | 1.21 | 0.71 | 1.10 |
| **Experimental Field Station Mean** | **6/29/2022** | **9/28/2022** | **1.16 J[3]** | **0.57 J** | **0.88 J** |
| | | | | | |
| Sand Dunes Tower | 6/29/2022 | 8/10/2022 | 0.33 | 0.30 | 0.48 |
| Sand Dunes Tower | 8/10/2022 | 8/25/2022 | 0.62 | 0.75 | 1.23 |
| Sand Dunes Tower | 8/25/2022[4] | 9/28/2022 | 0.48 J[1] | 0.54 J | 0.88 J |
| **Sand Dunes Tower Mean** | **6/29/2022** | **9/28/2022** | **0.43 J[3]** | **0.45 J** | **0.74 J** |
| | | | | | |
| Van Buren Avenue | 6/29/2022 | 7/20/2022 | 0.68 | 0.47 | 0.75 |
| Van Buren Avenue | 7/20/2022 | 8/17/2022 | 0.32 | 0.60 | 0.99 |
| Van Buren Avenue | 8/17/2022 | 9/01/2022 | 0.84 | 0.64 | 1.03 |
| Van Buren Avenue | 9/01/2022[4] | 9/28/2022 | 0.52 J[1] | 0.47 J | 0.77 J |
| **Van Buren Avenue Mean** | **6/29/2022** | **9/28/2022** | **0.58 J[3]** | **0.54 J** | **0.87 J** |
| | | | | | |
| **Boundary Locations** | | | | | |
| Atomic City | 6/29/2022 | 7/20/2022 | 0.73 | 0.56 | 0.89 |
| Atomic City | 7/20/2022 | 8/11/2022 | 0.59 | 0.57 | 0.93 |
| Atomic City | 8/11/2022 | 8/25/2022 | 0.00 | 0.72 | 1.24 |
| Atomic City | 8/25/2022 | 9/14/2022 | 0.29 J[1] | 0.41 J | 0.68 J |
| Atomic City | 9/14/2022[4] | 9/28/2022 | 0.96 | 0.60 | 0.94 |
| **Atomic City Mean** | **6/29/2022** | **9/28/2022** | **0.52 J[3]** | **0.56 J** | **0.92 J** |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Howe | 6/29/2022 | 7/20/2022 | -0.08 | 0.59 | 1.03 |
| Howe | 7/20/2022 | 8/11/2022 | 0.05 | 0.71 | 1.21 |
| Howe | 8/11/2022[4] | 8/25/2022 | 0.39 J[1] | 0.79 J | 1.33 J |
| Howe | 8/25/2022 | 9/14/2022 | 0.15 | 0.48 | 0.82 |
| Howe | 9/14/2022 | 9/28/2022 | 1.51 | 0.67 | 1.02 |
| **Howe Mean** | **6/29/2022** | **9/28/2022** | **0.35 J[3]** | **0.63 J** | **1.05 J** |
| | | | | | |
| Mud Lake | 6/29/2022 | 7/20/2022 | 0.08 | 0.73 | 1.26 |
| Mud Lake | 7/20/2022 | 8/03/2022 | 0.60 | 0.78 | 1.29 |
| Mud Lake | 8/03/2022 | 8/18/2022 | 0.74 | 0.99 | 1.64 |
| Mud Lake | 8/18/2022[4] | 9/01/2022 | 0.89 J[1] | 0.79 J | 1.28 J |
| Mud Lake | 9/01/2022 | 9/14/2022 | 0.05 | 0.65 | 1.11 |
| Mud Lake | 9/14/2022 | 9/28/2022 | 0.57 | 0.68 | 1.11 |
| **Mud Lake Mean** | **6/29/2022** | **9/28/2022** | **0.45 J[3]** | **0.76** | **1.27** |
| | | | | | |
| Monteview | 6/29/2022 | 7/28/2022 | 0.45 | 0.84 | 1.40 |
| Monteview | 7/28/2022 | 8/10/2022 | 1.71 | 0.97 | 1.50 |
| Monteview | 8/10/2022 | 9/01/2022 | 0.79 J[1] | 0.75 J | 1.22 J |
| Monteview | 9/01/2022[4] | 9/28/2022 | 0.00 | 0.59 | 1.02 |
| **Monteview Mean** | **6/29/2022** | **9/28/2022** | **0.57 J[3]** | **0.75 J** | **1.24 J** |
| | | | | | |
| **Distant Locations** | | | | | |
| Craters of the Moon | 6/29/2022 | 7/20/2022 | 0.07 J[2] | 0.49 J | 0.84 J |
| Craters of the Moon | 7/20/2022 | 8/10/2022 | 0.47 | 0.47 | 0.77 |
| Craters of the Moon | 8/10/2022[4] | 8/25/2022 | 0.49 J[1] | 0.65 J | 1.07 J |
| Craters of the Moon | 8/25/2022 | 9/28/2022 | 0.42 | 0.39 | 0.63 |
| **Craters of the Moon Mean** | **6/29/2022** | **9/28/2022** | **0.36 J[3]** | **0.49 J** | **0.81 J** |
| | | | | | |
| Fort Hall[5] | 6/29/2022 | 8/03/2022 | 0.35 | 0.56 | 0.93 |
| Fort Hall | 8/03/2022 | 9/07/2022 | -0.22 | 0.61 | 1.07 |
| Fort Hall | 9/07/2022 | 9/28/2022 | 1.14 | 0.62 | 0.95 |
| **Fort Hall Mean** | **6/29/2022** | **9/28/2022** | **0.37** | **0.59** | **0.98** |
| | | | | | |
| Idaho Falls | 6/29/2022 | 7/20/2022 | 0.42 | 0.60 | 1.00 |
| Idaho Falls | 7/20/2022 | 8/03/2022 | 0.68 | 0.76 | 1.25 |
| Idaho Falls | 8/03/2022 | 8/17/2022 | 0.65 | 0.92 | 1.52 |
| Idaho Falls | 8/17/2022[4] | 9/01/2022 | 0.39 J[1] | 0.65 J | 1.09 J |
| Idaho Falls | 9/01/2022 | 9/14/2022 | 0.79 | 0.55 | 0.88 |
| Idaho Falls | 9/14/2022 | 9/28/2022 | 0.74 | 0.63 | 1.01 |
| **Idaho Falls Mean** | **6/29/2022** | **9/28/2022** | **0.60 J[3]** | **0.68 J** | **1.11 J** |

Note: Concentrations are reported in pCi/m$^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]Air volume was estimated. Results are qualified as (usable) estimates (J).
[2]Mass of water collected was estimated. Results are qualified as (usable) estimates (J).
[3]One or more individual results for this location are qualified as estimates. Weighted mean is therefore qualified as an estimate (J).
[4]New gas meter deployed during this sampling period.
[5]Operated by the Shoshone-Bannock Tribes.

**Table 8. Tritium and gamma-emitting radionuclide concentrations from precipitation, third quarter, 2022.**

| Station Location | Start Date | Stop Date | Tritium | | | Cs-137 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| **On-site Locations** | | | | | | | | |
| Big Lost River Rest Area | 06/29/22 | 08/25/22 | -10 | 90 | 150 | 1.2 | 1.7 | 2.8 |
| Big Lost River Rest Area | 08/25/22 | 09/28/22 | 100 | 100 | 160 | 1.0 | 1.3 | 2.2 |
| **Big Lost River Rest Area Mean** | 06/29/22 | 09/28/22 | 24 | 93 | 153 | 1.1 | 1.6 | 2.6 |
| **Boundary Locations** | | | | | | | | |
| **Atomic City** | 06/29/22 | 09/28/22 | 100 | 90 | 150 | 1.7 | 2.1 | 3.5 |
| | | | | | | | | |
| **Howe** | 06/29/22 | 09/28/22 | 0 | 90 | 160 | 0.1 | 0.7 | 2.5 |
| | | | | | | | | |
| **Mud Lake** | 06/29/22 | 09/28/22 | 90 | 100 | 160 | 0.0 | 1.5 | 2.7 |
| | | | | | | | | |
| **Monteview** | 06/29/22 | 09/28/22 | 30 | 100 | 160 | -0.6 | 1.5 | 2.7 |
| **Distant Locations** | | | | | | | | |
| **Idaho Falls** | 06/29/22 | 09/28/22 | 100 | 100 | 160 | -1.0 | 1.2 | 2.3 |

Note: Concentrations are reported in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

# Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the third quarter of 2022 (**Figure 1**). To detect gamma radiation, each station is instrumented with triplicate electret ionization chambers (EIC), and 10 of the stations also are equipped with an EcoGamma gamma radiation monitor with low and high range Geiger–Müller detectors (**Table 9**).

The Shoshone-Bannock Tribes operate an air monitoring station at Fort Hall which is also equipped with EICs and an EcoGamma, both of which are owned and operated by the DEQ-INL OP. The DEQ-INL OP reports these results as a distant site.

EcoGammas are instruments capable of real-time measurements and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the EcoGammas at each location are transmitted to DEQ-INL OP and presented graphically via the worldwide web at https://www.deq.idaho.gov/idaho-national-laboratory-oversight/inl-oversight-program/gamma-radiation-measurements. Historically, DEQ-INL OP has used high-pressure ion chambers (HPIC) for real-time gamma radiation measurements. We completed a change-over of removing the old HPICs and replacing them with EcoGammas at each of our monitoring stations in first quarter 2021. Slight differences between EcoGamma data and historical HPIC data are expected.

EICs are a passive-integrating system that provides a cumulative measure of environmental gamma radiation exposure in the field. EICs are deployed, collected, and analyzed quarterly. EICs offer an inexpensive methodology to measure gamma radiation over a wide area, particularly in regions which do not have a power source. EICs can also provide valuable gamma radiation data in the event of an emergency. For this reason, EICs are deployed at 67 locations by DEQ-INL OP in a widespread network around the INL measuring external radiation. This information is tabulated in **Appendix B.**

These two systems are used by DEQ-INL OP to measure external gamma radiation for various radiological monitoring objectives. **Table 10** lists the average and median radiation exposure rates and exposure rate ranges measured by the EcoGammas for third quarter 2022. **Table 11** lists the EIC monitoring results for third quarter 2022. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation with one exception. The Mud Lake/Terreton EcoGamma 5-minute radiation readings spiked from a typical background level of about 19 µR/hr to 69 µR/hr at 11:25 AM on 8/13/22. The readings then decreased every 5-minutes to 43 µR/hr at 11:50 AM, and then fell to a background level of 19 µR/hr at 11:55 AM. Possible causes of this small radiation level increase include: 1) an equipment transient condition caused by a power surge, generating a false positive reading despite the use of a surge suppressor. Power surges are known to occur at this location per the property owners; 2) a person in the vicinity with a radioactive isotope from a medical procedure; or 3) a small airborne release from the INL. An INL origin is unlikely with no indication of radioactive contamination in rain or air samples, and no higher-than-background readings at EcoGamma locations closer to potential airborne activity release locations on the INL. INL meteorological data, including wind direction and speed, leading up to the spike also shows an INL airborne release to be a very unlikely cause. The maximum 69 µR/hr level for a 30-minute time duration is not a public health concern.

**Table 9. Summary of instrumentation at radiation monitoring stations.**

| Station Location | Instrument Type | |
|---|---|---|
| | HPIC | EIC |
| **On-site Locations** | | |
| Base of Howe | ■ | ■ |
| Big Lost River Rest Area | ■ | ■ |
| Experimental Field Station | | ■ |
| Rover | ■ | ■ |
| Sand Dunes Tower | ■ | ■ |
| Van Buren Avenue | | ■ |
| **Boundary Locations** | | |
| Atomic City | ■ | ■ |
| Big Southern Butte | ■ | ■ |
| Howe Met Tower | ■ | ■ |
| Monteview | ■ | ■ |
| Mud Lake/Terreton | ■ | ■ |
| **Distant Locations** | | |
| Craters of the Moon | | ■ |
| Fort Hall | ■ | ■ |
| Idaho Falls | ■ | ■ |

**Table 10. Average, median, and range of gamma exposure rates, third quarter 2022, from EcoGamma network.**

| Station Location | Exposure Rate (µR/hr) | | | |
|---|---|---|---|---|
| | Quarterly Average* | ± 2 SD | Median | Range** |
| **On-site Locations** | | | | |
| Base of Howe | 16.5 | 5.3 | 17.5 | 11.9 – 26.0 |
| Big Lost River Rest Area | 14.9 | 2.2 | 14.6 | 12.1 – 22.9 |
| Rover | 15.4 | 2.0 | 15.2 | 12.4 – 22.4 |
| Sand Dunes Tower | 14.6 | 1.9 | 14.4 | 12.2 – 22.2 |
| **Boundary Locations** | | | | |
| Atomic City | 14.7 | 2.3 | 14.4 | 11.8 – 21.5 |
| Big Southern Butte | 14.6 | 1.2 | 14.6 | 11.4 – 19.3 |
| Howe Met Tower | 14.1 | 2.4 | 14.1 | 11.1 – 21.7 |
| Monteview | 13.6 | 1.1 | 13.5 | 11.6 – 20.6 |
| Mud Lake / Terreton | 15.8 | 6.0 | 14.2 | 11.2 – 68.8 |
| **Distant Locations** | | | | |
| Fort Hall | 13.4 | 2.3 | 13.2 | 10.6 – 24.9 |
| Idaho Falls | 15.1 | 2.2 | 15.3 | 11.9 – 20.0 |

*The EcoGammas are sensitive electronic devices that can experience intermittent malfunctions and/or interference; this typically results in characteristic positive and/or negative data spikes. These aberrations are removed from the data set based on the judgement of the data analyst.
**The range of background exposure rates from EcoGamma data collected to date is approximately 9 – 34 µR/hr.

**Table 11. Electret ionization chamber (EIC) cumulative average exposure rates, third quarter, 2022.**

| Station Location | Exposure Rate (µR/hr) | |
|---|---|---|
| | Quarterly Average[1] | ± 2 SD |
| **On-Site Locations** | | |
| Base of Howe | 11.7 | 3.7 |
| Big Lost River Rest Area | 15.7 | 4.1 |
| Experimental Field Station | 13.7 | 2.5 |
| Rover | 17.2 | 3.7 |
| Sand Dunes Tower | 13.6 | 2.5 |
| Van Buren Avenue | 13.9 | 4.3 |
| **Boundary Locations** | | |
| Atomic City | 14.2 | 2.3 |
| Big Southern Butte | 14.2 | 0.4 |
| Howe Met Tower | 11.6 | 2.9 |
| Monteview | 12.4, 12.4 | - |
| Mud Lake/Terreton | 12.6, 14.6 | - |
| **Distant Location** | | |
| Craters of the Moon | R[2] | R[2] |
| Fort Hall | 15.1 | 3.5 |
| Idaho Falls | 11.3 | 3.4 |

[1]Results are the average of triplicate exposure rate measurements with the associated sample variability (±2 SD), or the 2 measured exposure rates remaining after removal of an outlying value. One of the triplicate measurements is rejected if it is outside the average of the triplicate measurements ±2 SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.

[2]An individual EIC cap was loose/off upon can removal. Wide variation among triplicate exposure rate measurements, with no consistency between pairs of measurements. All results for this location were rejected (R).

# Water Monitoring Results

DEQ-INL OP collects groundwater samples from wells and springs located within, upgradient of, and downgradient of the INL to evaluate the effects of INL contaminants on water quality in the eastern Snake River Plain (ESRP) aquifer and verify the results of DOE and USGS monitoring. Each year, DEQ-INL OP samples approximately 85-90 locations concurrently with a DOE contractor or the USGS and 15-20 locations independently. Co-sampled locations are primarily on or near the INL Site and are usually sampled during the second and fourth calendar quarters. DEQ-INL OP publishes a comparison of its own analytical results with those obtained by co-samplers in the DEQ-INL Oversight Program Annual Report. Locations sampled independently by DEQ-INL OP are mostly in the Magic Valley and are typically sampled during the third calendar quarter.

Most water samples are collected from wells drilled into the aquifer or springs formed by the intersection of the aquifer water table with the surface. Each aquifer well or spring is categorized as upgradient, facility, boundary, or distant based on its location (**Figure 2** and **Figure 3**):

- *Upgradient* sites are situated north or northeast of INL facilities in areas that have not been affected by INL operations. They are used to monitor background concentrations in the aquifer.

- *Facility* sites are located near facility complexes within the INL, including the Advanced Test Reactor complex (ATR), the Central Facilities Area (CFA), the Idaho Nuclear Technology and Engineering Center (INTEC), the Materials and Fuels Complex (MFC), the Naval Reactors Facility (NRF), the Radioactive Waste Management Complex (RWMC), and Test Area North (TAN). Facility sites are located within or immediately downgradient of known areas of

contamination and are sampled to monitor the concentrations and migration of specific contaminants.

- *Boundary* sites are located near the southern boundary of the INL, downgradient of potential sources of INL contamination. These include several wells equipped with Westbay Multilevel Groundwater Monitoring Systems ("Westbay wells"), which offer a look at the vertical distribution of constituents in the aquifer.

- *Distant* sites are located farther downgradient of the INL, primarily in the Magic Valley, and include wells and springs used for agricultural, municipal, domestic, and industrial purposes.

A small number of samples are also collected each year from streams, waste-pond effluent, and wells drilled into perched groundwater (groundwater that sits above the aquifer).

Samples collected from water-monitoring sites are analyzed for radiological and non-radiological constituents, many of which are present in the aquifer both naturally and as a result of INL operations. All locations are sampled for gross alpha and gross beta radioactivity, manmade gamma-emitting nuclides, tritium, chloride, sulfate, chromium, and nitrate-plus-nitrite.[1] Samples from locations at which tritium concentrations are too low to be detected by the standard method are re-analyzed for tritium using an electrolytic enrichment method (referred to as the low-level method), which has a minimum detectable concentration (MDC) about ten times lower than the standard method. Selected sites are also sampled for specific radionuclides—including uranium isotopes ($^{234}$U, $^{235}$U, and $^{238}$U), plutonium isotopes ($^{238}$Pu, $^{239/240}$Pu), americium-241 ($^{241}$Am), strontium-90 ($^{90}$Sr), iodine-129 ($^{129}$I), and technetium-99 ($^{99}$Tc)—selected trace metals, common ions, total phosphorous, and/or volatile organic compounds (VOCs) based on past and present INL operations or a history of elevated concentrations. If unexpected levels of radioactivity are detected in gross measurements, additional samples will be collected and analyzed for specific radionuclides.

During the third quarter of 2022, DEQ-INL OP sampled groundwater from the aquifer at one facility location, and 14 distant locations. **Table 12** lists the sample date, co-sampler, well depth, and analyses requested for the locations sampled this quarter. Analytical results are reported in **Tables 14 through 23** and summarized below. The results of low-level tritium analyses for eight samples collected in second quarter 2022, along with eleven samples collected in third quarter, 2022, are reported in **Table 16** and discussed below.

**Table 13** shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary MCL. Background concentrations depend on local geology, and the concentrations of constituents at sites not influenced by INL activities may on occasion be higher than the given background ranges due to local factors and natural variability.

*Gross alpha and gross beta radioactivity*

Gross alpha and gross beta analyses are used to screen for unexpectedly high levels of radioactivity in samples. DEQ-INL OP has determined from past sampling that background concentration ranges for gross alpha and gross beta radioactivity in the ESRP aquifer are approximately 0-5.6 pCi/L and 0-8.6 pCi/L, respectively. Occasional measurements of concentrations above these background ranges in uncontaminated samples are statistically probable due to uncertainties inherent in measuring low levels of radioactivity. Additionally, some samples will have levels of radioactivity slightly higher than

[1] Distant locations Alpheus Spring, Bill Jones Hatchery, Clear Spring, Minidoka Water Supply, and Shoshone Water Supply and upgradient location Mud Lake Water Supply are sampled for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second quarter. In the fourth quarter, samples are collected for common ions, metals, nitrate-plus-nitrate, and other constituents along with gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium.

background ranges due to higher-than-average concentrations of naturally occurring uranium, thorium, or potassium-40.

Gross alpha and beta radioactivity were detected at low levels in most samples (**Table 14)**. Gross alpha radioactivity was measured at concentrations within the known background range at all facility and distant locations. Distant well MV-27 had the highest gross alpha concentration at 2.4 ± 1.2 pCi/L, MDC = 1.7 pCi/L. This value is within background levels and is consistent with previous data. For example, in 2019, the gross alpha concentration was 3.3 ± 1.7 pCi/L, MDC = 2.5 pCi/L. Facility well TAN-2336 had the highest gross beta concentration of 885.9 ± 38.3 pCi/L, MDC = 31.7 pCi/L, which is down from 1592.5± 51.2 pCi/L, MDC = 34 pCi/L in May 2022. The gross beta concentration is consistent with results from other aquifer wells located at the TAN facility. Gross beta concentrations measured in the distant wells were within the known background range and consistent with historical trends.

In the second quarter of 2022, USGS-092, a perched well that was sampled at the RWMC facility, resulted in high gross alpha (56.9 ± 17 pCi/L, MDC = 17.3 pCi/L) and gross beta (54.8 ± 17.3 pCi/L, MDC = 25.7 pCi/L) concentrations. It was requested that the lab reanalyze the sample based on the initial results. Samples taken from this well typically contain an abundance of sediment due to the chronically low water volumes. The only difference between the original analysis and the reanalysis is that the lab filtered the water for the reanalysis. Results for gross alpha were 23.7 ± 11.7 pCi/L, MDC = 16.5 pCi/L. Gross beta results were 25.8 ± 10.1 pCi/L, MDC = 15.6 pCi/L. The lower results are consistent with filtering of the sample. Future monitoring of this location is scheduled for the second quarter of 2023.

*Manmade gamma-emitting radionuclides*

TAN-2336 had a questionable detection of 4.0 ± 0.9 pCi/L for cesium-137. A recount produced a <MDC result of 2.3 pCi/L (MDC = 3.8 pCi/L). The duplicate sample result (2.2 pCi/L) was also <MDC (MDC = 2.4 pCi/L). No other manmade gamma-emitting radionuclides were detected at the locations sampled this quarter. Results for cesium-137 ($^{137}$Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 14**.

*Tritium*

Tritium was measured at all locations sampled this quarter (**Table 15**). Using the standard analytical method, which typically has an MDC of 110 to 190 pCi/L, tritium was detected at facility well TAN-2336 (379 ± 110 pCi/L, MDC = 150 pCi/L). This value is typical of wells located at the TAN facility. There were no tritium detections using the standard analysis method for any of the distant wells sampled this quarter.

Eight samples from second quarter and eleven samples from third quarter, 2022 requiring low-level tritium analyses were evaluated this quarter. Results are reported in **Table 16**. One sample was from the TAN facility, seven were from boundary wells and the remaining eleven were from distant water locations. The highest concentration of low-level tritium was 192 ± 15 pCi/L, MDC = 13 in USGS-105 (952 ft bgs) and 189 ± 13 pCi/L, MDC = 11 in USGS-105 (1072 ft bgs), which are consistent with results from previous years. These elevated tritium concentrations in boundary wells indicate an INL tritium source. All reported concentrations for the distant wells are within the background range (≤ 33 pCi/L). A backlog of four samples to be analyzed for low-level tritium remains.

All tritium concentrations reported in this quarter are well below the drinking water MCL of 20,000 pCi/L.

*Strontium-90*

One aquifer facility location (TAN-2336) was sampled for $^{90}Sr$ this quarter (**Table 17**). An elevated concentration of 327 ± 77 pCi/L, MDC = 1 pCi/L was measured in the sample, which is consistent with previous concentrations reported from this well.

*Uranium Isotopes*

One aquifer location at the TAN facility was sampled for uranium isotopes ($^{234}U$, $^{235}U$, and $^{238}U$) this quarter; TAN-2336 (**Table 18**). Concentrations for $^{234}U$, $^{235}U$, and $^{238}U$ were all within background concentration levels. The $^{234}U/^{238}U$ ratio of 3.8 at TAN-2336 suggests a natural uranium source; however, this ratio has been higher in the last several years and typically indicates an anthropogenic uranium source. The $^{234}U/^{238}U$ ratio in the TAN-2336 duplicate sample is 6.6, indicating an anthropogenic uranium source.

*Iodine-129*

Four aquifer locations located at the INTEC facility and three aquifer locations located at the RWMC facility were sampled during the first and second quarters of 2022 for Iodine-129 **(Table 19)**. The samples were analyzed using the accelerator mass spectrometry (AMS) method, which allows for high selectivity, sensitivity, and precision. In a USGS study (Maimer and Bartholomay, 2019) that documented Iodine-129 sampling in 2017-2018 on the INL, concentration levels for USGS-067 were 0.877 ± 0.064 pCi/L, MDC = 0 pCi/L. The study noted that although USGS-067 had the largest concentration value of all wells in the study, USGS-067 continued to reflect a decreasing trend from results in 2011-2012 (1.02 ± 0.08 pCi/L, MDC = 0 pCi/L). During this quarter's sampling and similar to the USGS results, INTEC well USGS-067 resulted in the highest concentration at 0.83 ± 0.03 pCi/L, MDC = 0 pCi/L. INTEC well USGS-047 had the second highest concentration measured at 0.23 ± 0.01 pCi/L, MDC = 0 pCi/L. Pursuant to the USGS study, results for USGS-047 were 0.206 ± 0.016 pCi/L, MDC = 0 pCi/L. Two of the RWMC wells (M1S and M6S) located south of the RWMC facility resulted in non-detections. All concentrations are below the drinking water MCL of 1 pCi/L.

*Common ions, trace metals, and nutrients*

All locations were sampled for chloride, sulfate, alkalinity, chromium, and dissolved nutrients (nitrate-plus-nitrite) (**Tables 20, 21 and 22)**. Three locations (TAN-2336, MV-63, and MV-65) were sampled for additional common ions. TAN-2336 was the only location sampled for phosphorus and an expanded metals suite during the quarter.

Active bioremediation is occurring at TAN-2336. Bioremediation activities alter geochemical conditions in the aquifer, thus play a significant role in the mobilization of common ions, metals, and nutrients. Most analytes at TAN-2336 are above background concentrations and the INL OP will continue to monitor this location quarterly as remediation continues. TAN-2336 displayed elevated concentrations of chromium at 150 µg/L. This is decrease from the maximum chromium concentration of 440 µg/L that was measured in the previous quarter. Barium (1000 µg/L), iron (9300 µg/L), magnesium (81 mg/L), and manganese (980 µg/L) were detected above background concentrations and displayed a decrease in concentrations since the last quarter. TAN-2336 also displayed elevated concentrations of alkalinity, sodium, calcium, potassium, chloride, and phosphorus during the sampling period.

All analytes tested at distant wells were within background ranges, with exception of several sulfate and nitrate + nitrite results. Sulfate concentrations were above background levels for MV-05 (78.7 mg/L), MV-13 (58.5 mg/L), MV-27 (67.9 mg/L), and MV-65 (59.2 mg/L), however, these concentrations were consistent with previous trends. MV-53 displayed above background concentrations of nitrate + nitrite (6.4 mg/L), sulfate (85 mg/L), and chloride (71.9 mg/L). Nitrate + nitrite values at MV-53 have been

trending upward since 2004, but concentrations are still below the drinking water MCL of 10 mg/L. MV-53 sulfate and chloride concentrations were consistent with previous values. Elevated nitrate + nitrite, sulfate, and chloride at any distant well is likely associated with agricultural practices in the Magic Valley.

*Volatile organic compounds (VOCs)*

Two VOCs, which represent side reactions to the on-going in-situ bioremediation process, were detected at TAN-2336 during this quarter (**Table 23**); 2-Hexanone (9.4 µg/L) and 2-Butanone (methyl ethyl ketone) (335 µg/L). There are currently no federal standards for these analytes.

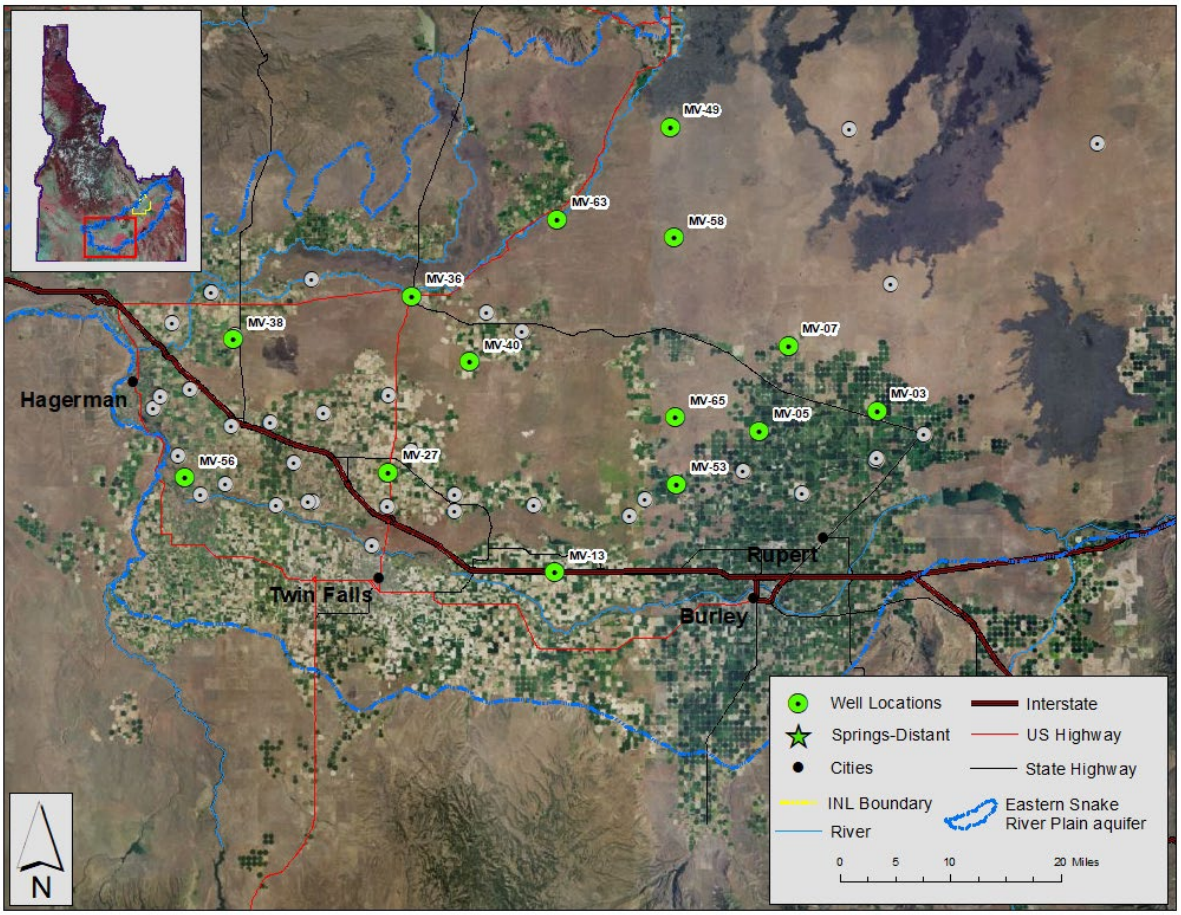


**Figure 2. Distant and Surface Water monitoring locations.**

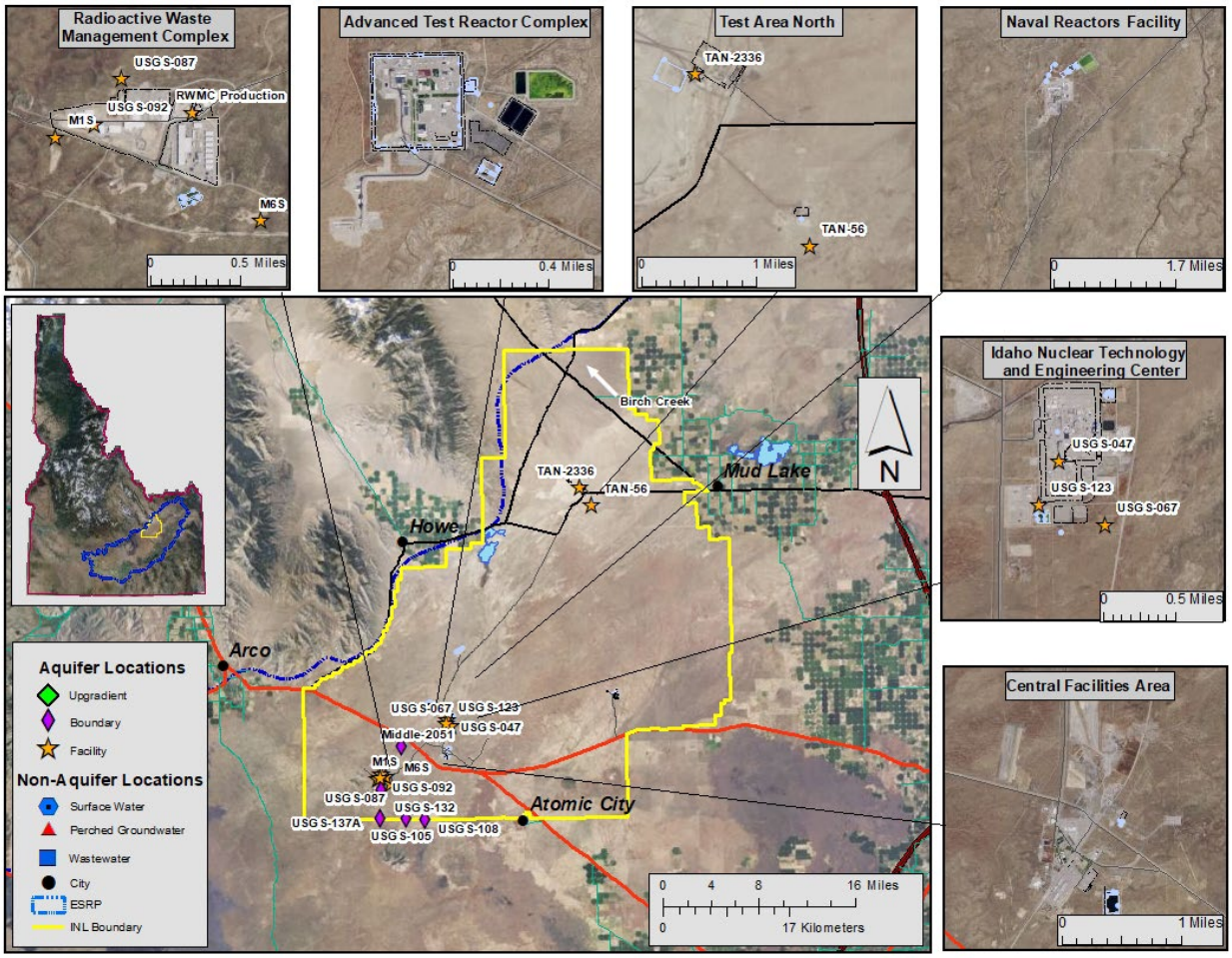


**Figure 3. Up-gradient, facility, boundary, perched groundwater, and wastewater monitoring locations.**

**Table 12. Locations sampled for water, third quarter, 2022.**

| Sample Location | Date Sampled | Co-sampler | Well Depth (ft bgs) | Analyses* |
|---|---|---|---|---|
| **Aquifer Samples** | | | | |
| **Facility** | | | | |
| ***Test Area North*** | | | | |
| TAN-2336 | 7/12/2022 | IEC | 255 | α, β, γ, $^{3}H$, $^{90}Sr$, U iso, com. ions, trace metals, $NO_3$+$NO_2$, P, VOCs |
| **Distant** | | | | |
| MV-03 | 7/19/2022 | None | 296 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-05 | 7/19/2022 | None | 388 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-07 | 7/19/2022 | None | 401 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-13 | 7/19/2022 | None | 390 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-27 | 9/06/2022 | None | 480 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-36 | 7/19/2022 | None | 355 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-38 | 7/20/2022 | None | n/a | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-40 | 7/19/2022 | None | 380 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-49 | 7/20/2022 | None | 426 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-53 | 7/19/2022 | None | 350 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-56 | 7/20/2022 | None | n/a | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-58 | 7/20/2022 | None | 454 | α, β, γ, $^{3}H$, Cl-, $SO_4^{2-}$, alk, Cr, $NO_3$+$NO_2$ |
| MV-63 | 08/15/2022 | None | 420 | α, β, γ, $^{3}H$, com. ions, Cr, $NO_3$+$NO_2$ |
| MV-65 | 08/15/2022 | None | 711 | α, β, γ, $^{3}H$, com. ions, Cr, $NO_3$+$NO_2$ |

ft bgs = feet below ground surface.
*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; $^{3}H$ = tritium; $^{90}Sr$ = Strontium-90; $^{99}Tc$ = Technetium-99; $^{129}I$ = Iodine-129; Pu iso. = plutonium isotopes $^{238}Pu$, $^{239/240}$ Pu, Pu; U iso. = uranium isotopes $^{234}U$, $^{235}U$, $^{238}U$; Cl = chloride; $SO_4^{2-}$ = sulfate; alk = alkalinity; Cr = chromium; com. ions = $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $K^{+}$, $Cl^{-}$, $SO_4^{2-}$, alkalinity; trace metals (metals) = arsenic ( As), barium (Ba), chromium (Cr), iron (Fe), manganese (Mn), lead (Pb), selenium (Se); $NO_3$+$NO_2$ = nitrate plus nitrite; P = phosphorus; and VOCs (volatile organic compounds).
n/a = well depth not available.

**Table 13. Constituent background concentration ranges and EPA drinking water standards.**

| Constituent | Background[1] | MCL or SMCL[2] |
|---|---|---|
| **Radiological Constituents (pCi/L)** | | |
| Gross alpha | 0-5.6[a] | 15 |
| Gross beta | 0-8.6[a] | 4 mrem/yr |
| Cesium-137 | 0 | 200 |
| Tritium | 0-33[a] | 20,000 |
| Strontium-90 | 0 | 8 |
| Technetium-99 | 0 | 900 |
| Iodine-129 | 0.0000054[e] | 1 |
| Uranium-234 | 0.043-1.9[b] | 30 µg/L (total U) |
| Uranium-235 | 0-0.048[b] | |
| Uranium-238 | 0.021-0.719[b] | |
| Plutonium-238 | 0 | --- |
| Plutonium-239/240 | 0 | --- |
| Americium-241 | 0 | --- |
| **Non-radiological Constituents** | | |
| *Common Ions (mg/L)* | | |
| Alkalinity (as $CaCO_3$) | 91-261[a] | --- |
| Calcium | 23 – 71[a] | --- |
| Chloride | 4.9 – 66.6[a] | 250* |
| Fluoride | 0.1 – 1.50[a] | 4 |
| Magnesium | 10.1 – 27.4[a] | --- |
| Potassium | 1.2 – 5.8[a] | --- |
| Sodium | 2.6 – 27.0[a] | --- |
| Sulfate | 9.6 – 40.4[a] | 250* |
| *Trace Metals (µg/L)* | | |
| Arsenic | 2 – 3[c] | 10 |
| Barium | 50 – 70[c] | 2000 |
| Chromium | <1.0 – 5.2[a] | 100 |
| Iron | 4 – 16[d] | 300* |
| Lead | <5[c] | 15 |
| Manganese | <1 – 4[a] | 50* |
| Selenium | <1[c] | 50 |
| Zinc | <3 – 10.5[d] | 5000* |
| *Nutrients (mg/L)* | | |
| Nitrate plus nitrite | <0.04 – 3.59[b] | 10 for $NO_3^-$, 1 for $NO_2^-$ |
| Phosphorus | <0.01 – 0.02[d] | --- |
| *Volatile Organic Compounds (µg/L)* | | |
| Tetrachloroethene (PCE) | 0 | 5 |
| Trichloroethene (TCE) | 0 | 5 |
| 1,1-Dichloroethene | 0 | 7 |
| cis-1,2-dichloroethene | 0 | 70 |
| trans-1,2-dichloroethene | 0 | 100 |
| Vinyl chloride | 0 | 2 |
| Carbon tetrachloride | 0 | 5 |
| Chloroform | 0 | 80[e] |
| Chloromethane | 0 | --- |
| Methylene Chloride | 0 | 5 |
| Methyl Ethyl Ketone | 0 | --- |
| 1,1-Dichloroethane | 0 | --- |

[1]Sources for background ranges are [a] DEQ data compiled from distant, boundary, and surface water sites from 1993-2018.
[b]Bartholomay and Hall, 2016 (DOE/ID-22237); [c] Knobel and others, 1992; [d] Knobel and others, 1999 (DOE/ID-22164); [e]Cecil and others, 2003 (DOE/ID-22186).
[2]Maximum Contaminant Levels (MCLs) are the highest levels of contaminants legally allowed in public drinking water systems in Idaho. Most wells sampled by DEQ-INL OP are not used for drinking water. A * designates a Secondary MCL (SMCL), which is a guideline recommended by the EPA for constituents that may affect the taste, color, or odor of drinking water. [e] MCL is for total trihalomethanes.

**Table 14. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) for water samples, third quarter, 2022.**

| Sample Location | Sample Date | Gross Alpha | | | Gross Beta | | | Cesium-137* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Concentration | | 2 SD | Concentration | | 2 SD | Concentration | | 2 SD |
| **Aquifer Samples** | | | | | | | | | | |
| **Facility** | | | | | | | | | | |
| ***Test Area North*** | | | | | | | | | | |
| TAN-2336 | 7/12/2022 | -1.3 | U | 17.2 | 885.9 | - | 38.3 | 4.0[1] | | 0.9 |
| **Other Samples** | | | | | | | | | | |
| **Perched Groundwater** | | | | | | | | | | |
| ***Radioactive Waste Materials Complex*** | | | | | | | | | | |
| USGS-092 (Reanalysis) | 4/18/2022 | 23.7 | - | 11.7 | 25.8 | - | 10.1 | - | - | - |
| **Distant** | | | | | | | | | | |
| MV-03 | 7/19/2022 | 1.8 | - | 0.8 | 2.5 | - | 0.8 | 0.7 | U | 1.7 |
| MV-05 | 7/19/2022 | 2.2 | - | 1.0 | 6.0 | - | 1.0 | -0.3 | U | 1.6 |
| MV-07 | 7/19/2022 | 1.4 | - | 0.7 | 4.6 | - | 0.8 | 0.5 | U | 2.2 |
| MV-13 | 7/19/2022 | 1.4 | - | 0.8 | 6.7 | - | 1.0 | 0.9 | U | 1.4 |
| MV-27 | 9/06/2022 | 2.4 | - | 1.2 | 6.3 | - | 1.1 | -1.1 | U | 1.3 |
| MV-36 | 7/19/2022 | 1.0 | U | 0.7 | 2.4 | - | 0.8 | 0 | U | 0.8 |
| MV-38 | 7/20/2022 | 0.4 | U | 0.7 | 5.1 | - | 0.9 | 0.7 | U | 1.8 |
| MV-40 | 7/19/2022 | 0.6 | U | 0.7 | 3.1 | - | 0.8 | 0.1 | U | 1.9 |
| MV-49 | 7/20/2022 | 1.7 | - | 0.9 | 2.7 | - | 0.8 | 0.2 | U | 0.7 |
| MV-53 | 7/19/2022 | 1.7 | - | 1.1 | 7.7 | - | 1.1 | 0 | U | 1.7 |
| MV-56 | 7/20/2022 | 0.9 | U | 0.8 | 3.8 | - | 0.9 | 0.9 | U | 1.3 |
| MV-58 | 7/20/2022 | 0.7 | U | 0.7 | 1.6 | - | 0.7 | 0.2 | U | 1.7 |
| MV-63 | 8/15/2022 | 1.0 | U | 0.8 | 1.5 | - | 0.8 | 0.7 | U | 1.8 |
| MV-65 | 8/15/2022 | 0.5 | U | 0.8 | 4.1 | - | 1.0 | -0.1 | U | 1.4 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range (gross alpha) 0.9 – 1.7 pCi/L. MDC range (gross beta) 1.2 – 1.6 pCi/L. MDC range (Cs-137) 2.2– 3.6 pCi/L. MDCs for TAN-2336 gross alpha (32.3 pCi/L) and gross beta (31.7 pCi/L) and for USGS-092 gross alpha (16.5 pCi/L) and gross beta (15.6 pCi/L) were larger due to high dissolved/suspended solids requiring a smaller aliquot for analysis.
*ISU-EML analyzes water samples for all common manmade gamma-emitting radionuclides. If none are detected, only the results for $^{137}Cs$, the manmade gamma-emitter most likely to be detected in groundwater, are reported in this table.
[1]This result is >MDC (MDC = 2.7 pCi/L) but questionable. A recount produced a <MDC result of 2.3 pCi/L (MDC = 3.8 pCi/L). The duplicate sample result (2.2 pCi/L) was also <MDC (MDC = 2.4 pCi/L).

**Table 15. Tritium concentrations (pCi/L) for water samples, third quarter, 2022.**

| Sample Location | Sample Date | Tritium | | |
|---|---|---|---|---|
| | | Concentration | | 2 SD |
| **Aquifer Samples** | | | | |
| **Facility** | | | | |
| ***Test Area North*** | | | | |
| TAN-2336 | 7/12/2022 | 379 | - | 110 |
| **Distant** | | | | |
| MV-03 | 7/19/2022 | 41 | U | 90 |
| MV-05 | 7/19/2022 | 50 | U | 90 |
| MV-07 | 7/19/2022 | 103 | U | 100 |
| MV-13 | 7/19/2022 | 96 | U | 100 |
| MV-27 | 9/06/2022 | 43 | U | 90 |
| MV-36 | 7/19/2022 | -34 | U | 90 |
| MV-38 | 7/20/2022 | 86 | U | 100 |
| MV-40 | 7/19/2022 | -34 | U | 90 |
| MV-49 | 7/20/2022 | 106 | U | 100 |
| MV-53 | 7/19/2022 | -58 | U | 90 |
| MV-56 | 7/20/2022 | 47 | U | 90 |
| MV-58 | 7/20/2022 | 11 | U | 90 |
| MV-63 | 8/15/2022 | 29 | U | 90 |
| MV-65 | 8/15/2022 | 52 | U | 90 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range 90 – 110 pCi/L.

**Table 16. Low-level tritium concentrations (pCi/L) in samples collected during 2022 and analyzed using the electrolytic enrichment method, third quarter, 2022.**

| Sample Location | Sample Date | Tritium | | |
|---|---|---|---|---|
| | | Concentration | | 2 SD |
| **Aquifer Samples** | | | | |
| **Facility** | | | | |
| ***Test Area North*** | | | | |
| TAN-56 | 6/14/2022 | 4 | U | 7 |
| **Boundary** | | | | |
| Middle-2051 (1091 bgs) | 6/15/2022 | 120 | - | 12 |
| Middle-2051 (749 bgs) | 6/15/2022 | 168 | - | 14 |
| USGS-105 (1072 bgs) | 6/27/2022 | 189 | - | 13 |
| USGS-105 (952 bgs) | 6/27/2022 | 192 | - | 15 |
| USGS-108 (1172 ft bgs) | 6/28/2022 | 46 | - | 9 |
| USGS-132 (765 ft bgs) | 6/21/2022 | 115 | - | 9 |
| USGS-137A (747 ft bgs) | 6/22/2022 | 82 | - | 11 |
| **Distant** | | | | |
| MV-03 | 7/19/2022 | 0 | U | 8 |
| MV-05 | 7/19/2022 | 10 | U | 7 |
| MV-07 | 7/19/2022 | 2 | U | 7 |
| MV-13 | 7/19/2022 | 13 | - | 7 |
| MV-36 | 7/19/2022 | 9 | U | 7 |
| MV-38 | 7/20/2022 | 1 | U | 8 |
| MV-40 | 7/19/2022 | 7 | U | 8 |
| MV-49 | 7/20/2022 | 16 | - | 8 |
| MV-53 | 7/19/2022 | 9 | U | 8 |
| MV-56 | 7/20/2022 | 4 | U | 6 |
| MV-58 | 7/20/2022 | 4 | U | 7 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
ft bgs = feet below ground surface.
MDC range 6 – 15 pCi/L.

**Table 17. Strontium-90 concentrations (pCi/L) in water samples, third quarter, 2022.**

| Sample Location | Sample Date | Strontium-90 | | |
|---|---|---|---|---|
| | | Concentration | | 2 SD |
| **Aquifer Samples** | | | | |
| **Facility** | | | | |
| ***Idaho Nuclear Technology and Engineering Center*** | | | | |
| TAN-2336 | 7/12/2022 | 327 | - | 77 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC 1.0 pCi/L.

**Table 18. Uranium isotope concentrations (pCi/L) for water samples, third quarter, 2022.**

| Sample Location | Sample Date | Uranium-234 | | Uranium-235 | | | Uranium-238 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Concentration | 2 SD | Concentration | | 2 SD | Concentration | | 2 SD |
| **Aquifer Samples** | | | | | | | | | |
| **Facility** | | | | | | | | | |
| ***Idaho Nuclear Technology and Engineering Center*** | | | | | | | | | |
| TAN-2336 | 07/12/2022 | 0.65 | - | 0.19 | 0.036 | U* | 0.045 | 0.173 | - | 0.089 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*Result is >MDC but <2SD and is therefore considered a non-detection.
MDC range (U-234) 0.06 – 0.08 pCi/L. MDC range (U-235) 0.032 – 0.089 pCi/L. MDC range (U-238) 0.028 – 0.067 pCi/L. The MDC ranges are a result of a duplicate sample analysis at this location (See the Quality Assurance section).

**Table 19. Iodine-129 concentrations (pCi/L) for water samples, third quarter, 2022.**

| Sample Location | Sample Date | Iodine-129 | | |
|---|---|---|---|---|
| | | Concentration | | 2 SD |
| **Aquifer Samples** | | | | |
| **Facility** | | | | |
| ***Idaho Nuclear Technology and Engineering Center*** | | | | |
| USGS-123 | 3/02/2022 | 0.026 | - | 0.003 |
| USGS-047 | 3/28/2022 | 0.23 | - | 0.01 |
| USGS-067 | 3/29/2022 | 0.83 | - | 0.03 |
| USGS-087 | 4/20/2022 | 0.0063 | - | 0.0011 |
| RWMC Production | 4/14/2022 | 0.018 | - | 0.003 |
| M1S | 5/03/2022 | 0.00018 | U* | 0.00070 |
| M6S | 5/02/2022 | -0.00013 | U | 0.00054 |

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
Reported MDC is 0 pCi/L.
*Result is >MDC but <2SD and is therefore considered a non-detection.

**Table 20. Common ion concentrations (mg/L) in water samples, third quarter, 2022.**

| Sample Location | Sample Date | Calcium* | | Magnesium* | | Sodium* | | Potassium* | | Fluoride | | Chloride | | Sulfate | | Alkalinity† | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aquifer Samples** | | | | | | | | | | | | | | | | | |
| **Facility** | | | | | | | | | | | | | | | | | |
| ***Test Area North*** | | | | | | | | | | | | | | | | | |
| TAN-2336 | 07/12/2022 | 91[2] | - | 81[2] | - | 2600[3] | - | 17[2] | - | - | - | 101[2] | - | 1.05[2] | UJ | 5660 | - |
| **Distant** | | | | | | | | | | | | | | | | | |
| MV-03 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 23.0 | - | 32.1 | - | 128 | - |
| MV-05 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 64.4[2] | - | 78.7[2] | - | 184 | - |
| MV-07 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 14.6 | - | 32.3 | - | 128 | - |
| MV-13 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 36.1[1] | - | 58.5 | - | 196 | - |
| MV-27 | 9/06/2022 | - | - | - | - | - | - | - | - | - | - | 52.2[2] | - | 67.9[2] | - | 183 | - |
| MV-36 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 7.46 | - | 18.9 | - | 171 | - |
| MV-38 | 7/20/2022 | - | - | - | - | - | - | - | - | - | - | 10.2 | - | 21.0 | - | 150 | - |
| MV-40 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 11.2 | - | 25.2 | - | 132 | - |
| MV-49 | 7/20/2022 | - | - | - | - | - | - | - | - | - | - | 4.63 | - | 20.2 | - | 188 | - |
| MV-53 | 7/19/2022 | - | - | - | - | - | - | - | - | - | - | 71.9[2] | - | 85.0[2] | - | 226 | - |
| MV-56 | 7/20/2022 | - | - | - | - | - | - | - | - | - | - | 23.1 | - | 37.9 | - | 138 | - |
| MV-58 | 7/20/2022 | - | - | - | - | - | - | - | - | - | - | 6.96 | - | 11.1 | - | 108 | - |
| MV-63 | 8/15/2022 | 41 | - | 16 | - | 14 | - | 2.8 | - | - | - | 5.14 | - | 15.9 | - | 182 | - |
| MV-65 | 8/15/2022 | 51 | - | 20 | - | 33 | - | 4.4 | - | - | - | 49.0[1] | - | 59.2 | - | 162 | - |

Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*Samples are filtered for calcium, magnesium, sodium, and potassium.
†As $CaCO_3$.
"-" = not analyzed.
Note 1. Lab indicated that a 1:2 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:5 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 1:25 dilution of this sample was required for this analyte.

**Table 21. Dissolved metals concentrations (µg/L) in water samples, third quarter, 2022.**

| Sample Location | Sample Date | Arsenic | | Barium | | Chromium | | Iron | | Lead | | Manganese | | Selenium | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aquifer Samples** | | | | | | | | | | | | | | | | | |
| **Facility** | | | | | | | | | | | | | | | | | |
| ***Test Area North*** | | | | | | | | | | | | | | | | | |
| TAN-2336 | 07/12/2022 | 11[1] | UJ | 1000[2] | - | 150[1] | - | 9300[2] | - | 0 | U | 980[2] | - | - | - | - | - |
| **Distant** | | | | | | | | | | | | | | | | | |
| MV-03 | 7/19/2022 | - | - | - | - | 2.2 | - | - | - | - | - | - | - | - | - | - | - |
| MV-05 | 7/19/2022 | - | - | - | - | 1.9 | - | - | - | - | - | - | - | - | - | - | - |
| MV-07 | 7/19/2022 | - | - | - | - | 2.8 | - | - | - | - | - | - | - | - | - | - | - |
| MV-13 | 7/19/2022 | - | - | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| MV-27 | 9/06/2022 | - | - | - | - | 2.0 | - | - | - | - | - | - | - | - | - | - | - |
| MV-36 | 7/19/2022 | - | - | - | - | 2.1 | - | - | - | - | - | - | - | - | - | - | - |
| MV-38 | 7/20/2022 | - | - | - | - | 2.3 | - | - | - | - | - | - | - | - | - | - | - |
| MV-40 | 7/19/2022 | - | - | - | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - |
| MV-49 | 7/20/2022 | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - |
| MV-53 | 7/19/2022 | - | - | - | - | 1.3 | - | - | - | - | - | - | - | - | - | - | - |
| MV-56 | 7/20/2022 | - | - | - | - | 2.5 | - | - | - | - | - | - | - | - | - | - | - |
| MV-58 | 7/20/2022 | - | - | - | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - |
| MV-63 | 8/15/2022 | - | - | - | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - |
| MV-65 | 8/15/2022 | - | - | - | - | 2.0 | - | - | - | - | - | - | - | - | - | - | - |

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
"-" = not analyzed.
Note 1. Lab indicated that a 1:12.5 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:5 dilution of this sample was required for this analyte.

**Table 22. Dissolved nutrient concentrations (mg/L) in water samples, third quarter, 2022.**

| Sample Location | Sample Date | Nitrate + Nitrite* | | Total Phosphorus | |
|---|---|---|---|---|---|
| **Aquifer Samples** | | | | | |
| **Facility** | | | | | |
| ***Test Area North*** | | | | | |
| TAN-2336 | 07/12/2022 | 0.11 | - | 9.8[3] | - |
| **Distant** | | | | | |
| MV-03 | 7/19/2022 | 1.1 | - | - | - |
| MV-05 | 7/19/2022 | 3.7[1] | - | - | - |
| MV-07 | 7/19/2022 | 0.57 | - | - | - |
| MV-13 | 7/19/2022 | 2.5[1] | - | - | - |
| MV-27 | 9/06/2022 | 2.5[1] | - | - | - |
| MV-36 | 7/19/2022 | 1.5 | - | - | - |
| MV-38 | 7/20/2022 | 1.3 | - | - | - |
| MV-40 | 7/19/2022 | 0.82 | - | - | - |
| MV-49 | 7/20/2022 | 1.5 | - | - | - |
| MV-53 | 7/19/2022 | 6.4[2] | - | - | - |
| MV-56 | 7/20/2022 | 1.3 | - | - | - |
| MV-58 | 7/20/2022 | 1.5 | - | - | - |
| MV-63 | 8/15/2022 | 1.2 | - | - | - |
| MV-65 | 8/15/2022 | 2.2[1] | - | - | - |

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

*As N.
"-" = not analyzed.
Note 1. Lab indicated that a 1:2 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:10 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 1:50 dilution of this sample was required for this analyte.

**Table 23. Volatile organic compound concentrations (µg/L) in water samples, third quarter, 2022. Only VOCs detected this quarter or in the recent past are shown.**

| Sample Location | Sample Date | PCE | | TCE | | 1,1-DCE | | cis-1,2-DCE | | trans-1,2-DCE | | Vinyl Chloride | | 1,1,1 TCA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aquifer Samples** | | | | | | | | | | | | | | | |
| **Facility** | | | | | | | | | | | | | | | |
| ***Test Area North*** | | | | | | | | | | | | | | | |
| TAN-2336 | 07/12/2022 | <0.5 | U | <0.5 | U | <0.5 | U | <0.5 | U | <0.5 | U | <0.5 | U | <0.5 | U |

**Table 23 cont. Volatile organic compound concentrations (µg/L) in water samples, third quarter, 2022. Only VOCs detected this quarter or in the recent past are shown.**

| Sample Location | Sample Date | Carbon Tetrachloride | | Chloroform | | Chloro-methane | | 1,1-DCA | | 2-Butanone | | 2-Hexanone | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aquifer Samples** | | | | | | | | | | | | | |
| **Facility** | | | | | | | | | | | | | |
| ***Test Area North*** | | | | | | | | | | | | | |
| TAN-2336 | 7/12/2022 | <0.5 | U | <0.5 | U | <0.5 | U | <0.5 | U | 335 | - | 9.40 | J |

Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane; 1,1,1 TCA = 1,1,1-trichloroethane.

Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

# Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants and provide independent verification of DOE's terrestrial monitoring programs. Physical soil sampling and *in-situ* gamma spectrometry are used to characterize actual deposition and accumulation of radioactive contaminants in soils. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. No *in-situ* gamma spectroscopic measurements were performed, but 32 soil samples were physically collected and analyzed during the third calendar quarter of 2022.

## Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 ($^{40}$K) and man-made iodine-131 ($^{131}$I). Milk samples are collected on a monthly basis. Results for analyses of milk samples are presented in **Table 24**. $^{40}$K was detected in all samples within the expected range of concentration. $^{131}$I was not detected. Based on measurements of radionuclides in milk, there were no discernable impacts to the off-site environment from INL operations.

**Table 24. Gamma spectroscopy analysis data for milk samples, third quarter, 2022.**

| Sample Location/Dairy | Sample Date | Naturally occurring Potassium-40 | | Man-made Iodine-131 | | |
|---|---|---|---|---|---|---|
| | | Concentration[2] | ± 2 SD | Concentration[2] | ± 2 SD | MDC |
| **Monitoring Samples** | | | | | | |
| Shelley | 7/25/2022 | 1431 | 113 | 0.8 | 1.8 | 3.0 |
| Gooding | 7/19/2022 | 1671 | 118 | 0.4 | 1.7 | 2.8 |
| Gooding | 8/16/2022 | 1367 | 102 | -0.1 | 1.3 | 2.2 |
| Gooding | 9/14/2022 | 1447 | 106 | -0.1 | 1.1 | 1.8 |
| Roberts | 7/25/2022 | 1544 | 111 | 0.6 | 0.9 | 1.5 |
| **Verification Samples**[1] | | | | | | |
| Terreton | 7/06/2022 | 1544 | 111 | -0.6 | 1.2 | 2.1 |
| Minidoka | 8/02/2022 | 1584 | 113 | 0.2 | 1.4 | 2.4 |
| Dietrich | 9/06/2022 | 1480 | 106 | 0.2 | 1.5 | 2.4 |

[1]DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.
[2]Concentrations with associated uncertainties (± 2 SD) and minimum detectable concentrations (MDC) are expressed in pCi/L.

## Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation capable of identifying and measuring *in-situ* concentrations of gamma-emitting radionuclides in soil. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons. Thirty-two soil samples including six duplicates were collected and prepared in the field at thirteen locations (**see Figure 4**) during the third calendar quarter of 2022. $^{137}$Cs was the only man made gamma emitting radionuclide detected. Analysis results for $^{137}$Cs concentrations for physical soil samples are shown in **Table 25.**

**Table 25. Gamma spectroscopic analysis results ($^{137}Cs$) for physical soil sampling conducted during the third calendar quarter of 2022.**

| Location | Sample Type[1] | Sample Depth (cm) | Date Collected | Concentration[2] | ±2 SD | MDC |
|---|---|---|---|---|---|---|
| Atomic City | Puck | 0 to 5 | 07/26/22 | 0.28 | 0.09 | 0.10 |
| Atomic City | Puck | 5 to 10 | 07/26/22 | 0.08 U[3] | 0.06 | 0.10 |
| Blackfoot | Puck | 0 to 5 | 07/26/22 | 0.12 | 0.07 | 0.10 |
| Blackfoot | Puck | 5 to 10 | 07/26/22 | 0.03 U | 0.05 | 0.09 |
| Butte City | Puck | 0 to 5 | 07/26/22 | 0.33 | 0.10 | 0.10 |
| Butte City | Puck | 5 to 10 | 07/26/22 | 0.10 | 0.06 | 0.09 |
| Carey | Puck | 0 to 5 | 07/26/22 | 0.48 | 0.11 | 0.10 |
| Carey | Puck | 5 to 10 | 07/26/22 | 0.13 | 0.07 | 0.09 |
| Crystal Ice Caves | Puck | 0 to 5 | 08/04/22 | 0.34 | 0.10 | 0.11 |
| Crystal Ice Caves | Puck | 5 to 10 | 08/04/22 | 0.07 U | 0.06 | 0.10 |
| FAA Tower | Puck | 0 to 5 | 07/26/22 | 0.41 | 0.11 | 0.11 |
| FAA Tower | Puck | 5 to 10 | 07/26/22 | 0.12 | 0.07 | 0.10 |
| Frenchman's Cabin | Puck | 0 to 5 | 07/26/22 | 0.17 | 0.07 | 0.09 |
| Frenchman's Cabin | Puck | 5 to 10 | 07/26/22 | 0.01 U | 0.05 | 0.08 |
| Howe | Puck | 0 to 5 | 08/02/22 | 0.33 | 0.09 | 0.10 |
| Howe | Puck | 5 to 10 | 08/02/22 | 0.07 | 0.05 | 0.07 |
| Monteview | Puck | 0 to 5 | 08/02/22 | 0.28 | 0.08 | 0.09 |
| Monteview | Puck | 5 to 10 | 08/02/22 | 0.11 | 0.05 | 0.08 |
| Mud Lake #1 | Puck | 0 to 5 | 08/02/22 | 0.05 U | 0.05 | 0.08 |
| Mud Lake #1 | Puck | 5 to 10 | 08/02/22 | 0.02 U | 0.04 | 0.07 |
| Mud Lake #2 | Puck | 0 to 5 | 08/02/22 | 0.19 | 0.07 | 0.09 |
| Mud Lake #2 | Puck | 5 to 10 | 08/02/22 | 0.06 U | 0.05 | 0.09 |
| Reno Ranch | Puck | 0 to 5 | 08/02/22 | 0.49 | 0.11 | 0.11 |
| Reno Ranch | Puck | 5 to 10 | 08/02/22 | 0.02 U | 0.05 | 0.09 |
| St. Anthony | Puck | 0 to 5 | 08/02/22 | 0.39 | 0.10 | 0.09 |
| St. Anthony | Puck | 5 to 10 | 08/02/22 | 0.34 | 0.09 | 0.10 |

[1]Soil samples were collected in a "puck" (a cylindrical plastic container with a diameter of 6.5 cm and a height of 2.2 cm) and prepared in the field for gamma spectroscopic analysis at ISU.
[2]Concentrations reported in pCi/g.
[3]U = non-detection.

The average Cesium-137 value for the 0 to 5-cm samples was 0.39 picocuries per gram (pCi/g) with a minimum value of 0.05 pCi/g (less than MDC) and a maximum of 0.49 pCi/g. The average Cesium-137 value for the 5 to 10-cm samples was 0.09 picocuries per gram (pCi/g) with a minimum value of 0.01 pCi/g (less than MDC) and a maximum of 0.34 pCi/g. These values are all well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g (NCRP Report 129).

Based upon terrestrial radiological measurements of soil and milk, there were no discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

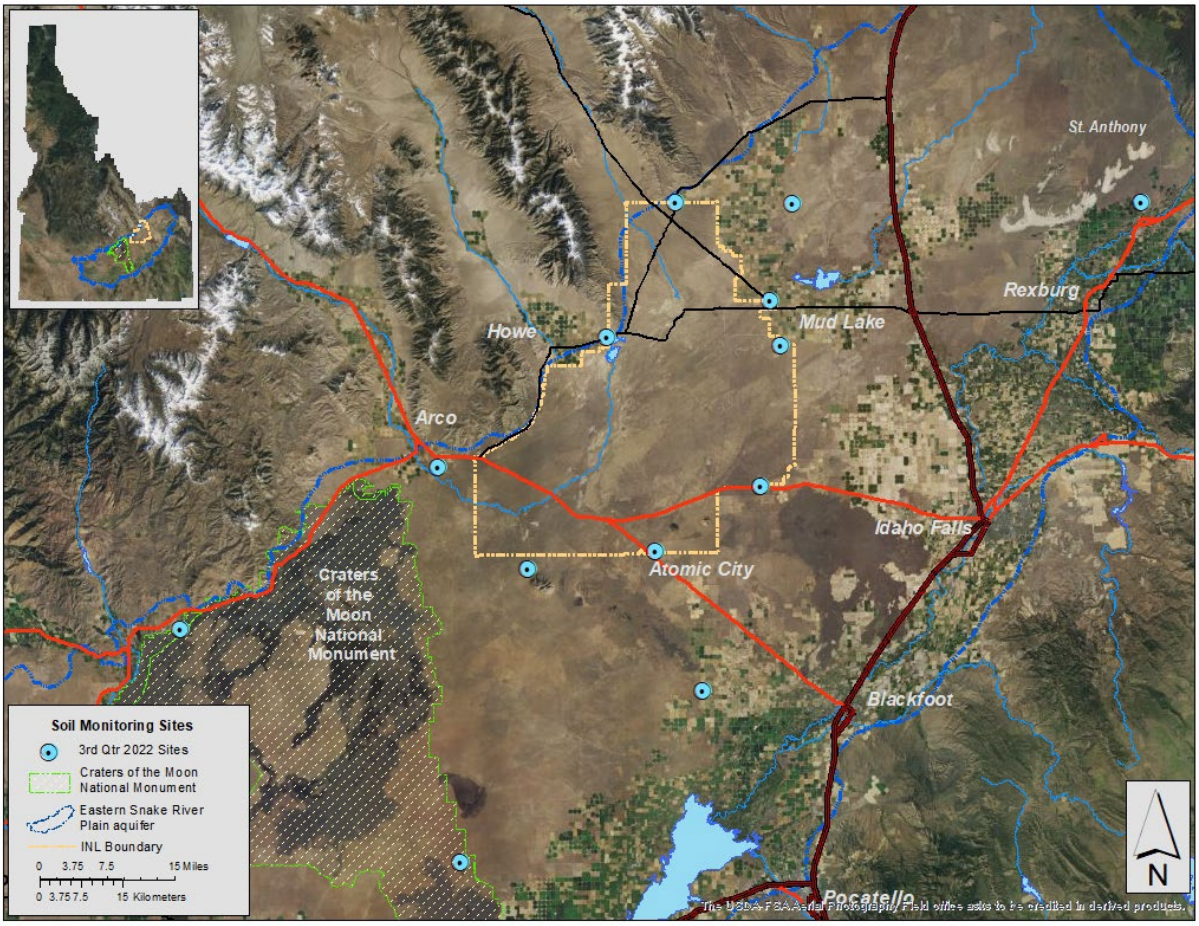


**Figure 4. Physical soil monitoring stations, third quarter 2022.**

# Quality Assurance

Measurements of constituent concentrations in environmental media are subject to inaccuracy from errors that may be introduced during the collection, transportation, and analysis of samples, calibration of equipment, and recording and reporting of results. While it is impossible to quantify every error that may affect a result, a quality assurance (QA) program can evaluate the overall quality of a dataset and, in many cases, identify and address errors or inaccuracies. DEQ-INL OP's QA program is designed to (1) ensure sample integrity, (2) evaluate the precision and accuracy of analytical results, and (3) ensure that the environmental data are representative and complete.

This section summarizes the quality assurance assessment of the data collected by DEQ-INL OP in the third quarter of 2022. Included are the results of quality control (QC) samples (blanks, duplicates, and spikes) that DEQ-INL OP submitted to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses and to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses during the quarter. The analytical results of QC samples are used to assess the precision, accuracy, and representativeness of the environmental data presented in this report. During the third quarter of 2022, DEQ-INL OP submitted 87 QC samples for various radiological and non-radiological analyses (**Table 26**).

All samples referenced in this report were collected in accordance with written procedures maintained by the DEQ-INL OP. Analytical methods and QC procedures used by the laboratories were performed in accordance with approved written procedures maintained by each lab. QC samples analyzed by the labs as part of each lab's internal QA program are not discussed in this report.

## Blank Samples

Blank samples consist of matrices that contain immeasurable or acceptably low concentrations of the analyte(s) of interest. They are used to monitor contamination introduced during sample collection, storage, shipment, and analysis. For water matrices, a blank sample consists of 18-megaohm deionized water from the DEQ-Idaho Falls Regional office and is categorized as a field blank, equipment blank, or trip blank depending on how the blank is handled. A field blank is used to monitor for contamination introduced from the environment during sample collection, an equipment blank is used to monitor for contamination introduced by contaminated equipment, and a trip blank is used to monitor for contamination introduced during transportation of samples (trip blanks are typically only used for VOCs). Most water blank samples submitted to laboratories by DEQ-INL OP are field blanks.

For all analyses except low-level tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For low-level tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 33 pCi/L.[2] If a blank result exceeds acceptance criteria, above-MDC results in other samples collected, transported, or analyzed together with the failed blank may be qualified as biased high (J+) or rejected (R), or may remain unqualified, depending on the relative sizes of the blank detection and other sample results.

Sample results for blank TSP filters submitted for gross alpha and gross beta screening in air for the third quarter of 2022 are presented in **Table 27**. Blank sample results for select gamma emitters in air from 47-mm TSP filter quarterly composites and 8x10-inch monthly composites are presented in **Table 28**. Blank sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from second quarter 2022 are presented in **Table 29.** Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 30**. Blank sample results for radiological analytes in

[2] The water used by DEQ-INL OP to create blank samples contains measurable concentrations of tritium produced cosmogenically and by above-ground testing of nuclear weapons during the twentieth century. The highest tritium concentration that DEQ considers acceptable in a blank is calculated as the mean tritium concentration in DEQ blanks from 2013 to 2017 plus two standard deviations (33 pCi/L).

groundwater are presented in **Table 31**. Blank sample results for metals and common ions and nutrients are presented in **Tables 32** and **33.**

The TSP 47-mm filter blank sample gross beta result was greater than its MDC for the week of 7/13/22-7/20/22. All 47-mm TSP gross beta results were qualified as biased-high estimates (J+ flagged) for that week. The second quarter 2022 8x10-inch TSP blank air filter composite Sr-90 value, and its recount, were greater than the MDC. All 8x10-inch TSP air filter composite Sr-90 results were qualified as estimates for the second quarter.

## Duplicate Samples

A duplicate sample is one that is collected at the same location and approximately the same time as another sample (referred to as the "original" sample). Duplicate sample results are compared to the original sample's results to evaluate reproducibility. Significant differences between the two could indicate poor analytical precision or a non-uniform sample matrix.

The difference between the results of an original and duplicate sample (referred to below as a "duplicate-sample pair") is evaluated differently for radiological and non-radiological analyses. For radiological analyses, the results of a duplicate-sample pair are considered to be in agreement if their absolute difference is less than or equal to three times the pooled error of the results:

$$|R_1 - R_2| \leq 3\sqrt{S_1^2 + S_2^2}$$

$R_1$ = Original sample result
$R_2$ = Duplicate sample result
$S_1$ = Analytical uncertainty (1 SD) of the original result
$S_2$ = Analytical uncertainty (1 SD) of the duplicate result

Duplicate radiological results are also considered to be in agreement if their relative percent difference (RPD) is no more than ±20 percent. RPD is calculated as:

$$RPD = \frac{R_1 - R_2}{(R_1 + R_2)/2} \times 100$$

For non-radiological analyses, the RPD is used to evaluate duplicate sample pairs in which both results exceed five times the MDC. An RPD of up to ±20 percent is acceptable. If one or both sample results is less than five times the MDC, the results agree if their absolute difference is less than or equal to the MDC.

Duplicate results for radiological analyses in groundwater and surface water are presented in **Table 34**. Duplicate results for metals, common ions and nutrients, and VOCs in groundwater are presented in **Tables 35, 36,** and **373.** Duplicate results for soil grab samples are presented in **Table 38**. The duplicate TAN-2336 sample 2-hexanone result disagreed with the original sample result, with an RPD of -38%. The original result was J-flagged as an estimate in the Water Monitoring section. All other duplicate sample results passed acceptance criteria in the third quarter of 2022.

## Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added. They are used to assess a laboratory's analytical accuracy. The percent recovery (%R) of each spiked-sample analysis is calculated as the ratio of the spike concentration determined by the lab to the known spike concentration. DEQ-INL OP considers the lab's result to be in control if the percent recovery is 100 ± 25%. If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample may be qualified as low-biased estimates (J-), and below-MDC results may be qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-

150%, above-MDC results of associated samples may be qualified as high-biased estimates (J+), and below-MDC results may be qualified as undetected (U). If the percent recovery of a spiked sample is <50% or >150%, the results of all associated samples may be qualified as rejected (R), except for sample results below MDC associated with a spiked-sample analysis having a percent recovery >150%, in which case the sample result remains qualified as undetected (U).

There were no spiked samples submitted to the laboratories for the third quarter, 2022.

DEQ-INL OP also prepares additional "spike-like" quality control samples to assess ambient radiation measurement bias. Once per quarter, DEQ-INL OP irradiates several electret ionization chambers (EICs) at ISU to verify EIC response. Irradiations of EICs are conducted in a repeatable geometry to a known exposure of near 30 mR and two additional higher and lower exposures, ranging from 15 to 60 mR. EIC responses are compared directly with the exposure received from the NIST traceable cesium-137 source provided by ISU-EML. EIC response is considered acceptable if each measurement has a percent recovery of 100 ± 25% when compared to the known irradiated quantity. Overall response for each control set is considered acceptable if the average of the three individual results for the set has a percent recovery of 100 ± 25%. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. The ISU irradiation results for third quarter 2022 are presented in **Table 39**. All individual EIC readings and all EIC control set averages passed the DEQ-INL OP acceptance criterion.

## Laboratory QC Issues

There were no laboratory QC issues to report in the third quarter of 2022.

## DEQ-INL OP Equipment QC Issue

A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of the 47-mm filter TSP air samplers. For several of these samplers, the rotameter-indicated stop flow rate was greater than the ± 10% error tolerance when compared with the calibrated flow rate gauge in the third quarter, 2022. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements, and results are considered (usable) estimates.

## Qualification of Low Level Sample Results

Sample results >MDC are generally considered detections, with the following exceptions[3] that apply primarily to radionuclide concentrations in water samples:

1. Results >MDC but ≤ 2SD are considered non-detections and U-flagged as undetected, where SD is the sample standard deviation.
2. Results >MDC and >2SD but <3SD are considered questionable detections and J-flagged as estimates.

## Analytical QA/QC Assessment

Other than those discussed above, no issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the third quarter of 2022 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 13.1% is acceptable and above the DEQ-INL OP minimum requirement of 10%. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the third quarter of 2022.

[3] Monitoring and Surveillance Committee, Consistency in Reporting Results Subcommittee Meeting Summary, 2/5/04 and 4/1/04.

Data usability is the measure of field sample results that are not rejected divided by the total number of field sample results obtained. The overall data usability (non-rejected results divided by the total number of field sample results reported) of 97.4% for the third quarter of 2022 well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 26**. The overall data completeness (usable results divided by the total number of field sample results expected) of 96.9% is also well above the acceptable value of 90%.

## Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. Service reliability for air sampling equipment for the third quarter of 2022 is summarized in **Table 40**.

## Conclusion

All data collected for the third quarter of 2022 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 97.4% and data completeness of 96.9% are well above the acceptable value of 90% for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP.

**Table 26. Summary of analyses in the third quarter, 2022.**

| Media Sampled | Collection Device | Analyte | Sample Analyses | Blank Analyses | Duplicate Analyses | Spike Analyses | Data Rejected[1] | Analyzing Lab[2] |
|---|---|---|---|---|---|---|---|---|
| **Air** | | | | | | | | |
| **Particulate** | 47-mm filters | Gross alpha | 142 | 13 | 0 | 0 | 8 | ISU-EML |
| | | Gross beta | 142 | 13 | 0 | 0 | 8 | ISU-EML |
| | 47-mm and 8x10" filters | Gamma emitters | 47 | 4 | 0 | 0 | 0 | ISU-EML |
| | 8x10" filters | Radiochemical | 12 | 1 | 0 | 0 | 0 | ISU Sub |
| **Water Vapor** | Desiccant column | Tritium | 48 | 4 | 0 | 0 | 0 | ISU-EML |
| **Gaseous** | Charcoal filter | Iodine-131 | 13 | 0 | 0 | 0 | 0 | ISU-EML |
| **Precipitation** | Poly bottle | Tritium | 7 | 0 | 0 | 0 | 0 | ISU-EML |
| | | Gamma emitters | 7 | 0 | 0 | 0 | 0 | ISU-EML |
| **Water** | | | | | | | | |
| **Groundwater & Surface Water** | Grab or composite | Gross alpha | 16 | 1 | 3 | 0 | 0 | ISU-EML |
| | | Gross beta | 16 | 1 | 3 | 0 | 0 | ISU-EML |
| | | Gamma emitters | 15 | 1 | 3 | 0 | 0 | ISU-EML |
| | | Tritium | 15 | 1 | 3 | 0 | 0 | ISU-EML |
| | | Low-level tritium | 19 | 3 | 2 | 0 | 0 | ISU-EML |
| | | Radiochemical[6] | 9 | 0 | 3 | 0 | 0 | ISU Sub |
| | | Metals | 15 | 1 | 3 | 0 | 0 | IBL |
| | | Common Ions | 15 | 1 | 3 | 0 | 0 | IBL |
| | | Nutrients | 15 | 1 | 3 | 0 | 0 | IBL |
| | | Volatile Organics | 1 | 0 | 1 | 0 | 0 | IBL |
| **Terrestrial** | | | | | | | | |
| **Milk** | Grab or composite | Gamma emitters | 8 | 0 | 0 | 0 | 0 | ISU-EML |
| **Soil** | *in situ* | Gamma emitters | 0 | 0 | 0 | 0 | 0 | DEQ-INL OP |
| | Grab – "puck" | Gamma emitters | 26 | 0 | 6 | 0 | 0 | ISU-EML |
| **Radiation** | | | | | | | | |
| **Ambient** | EICs | Gamma Radiation | 66 | 0 | 0 | 9 | 1 | DEQ-INL OP |
| | EcoGamma | Gamma Radiation | 11 | NA | NA | NA | 0 | DEQ-INL OP |
| **Total analyses performed** | | | **665** | **45** | **33** | **9** | **17** | |
| **Total QC analyses performed. (blanks, duplicates, and spikes)** | | | **87** | | | | | |
| **Ratio of total QC analyses to total sample analyses[3]** | | | **13.1%** | | | | | |
| **Data usability[4], percent** | | | **97.4%** | | | | | |
| **Data completeness[5], percent** | | | **96.9%** | | | | | |

[1]Combined Laboratory and DEQ-INL OP rejection criteria (data was rejected for any reason).

[2]ISU-EML = Idaho State University – Environmental Monitoring Laboratory; ISU Sub = Subcontract laboratory to ISU-EML; IBL = Idaho Bureau of Laboratories, Boise; IBL Sub = Subcontract laboratory to IBL; DEQ-INL OP = Analyzed by INL Oversight Program, Idaho Department of Environmental Quality.

[3]DEQ-INL OP requires that the number of QC analyses performed be at least 10 percent of the number of sample analyses performed.

[4]Data usability is calculated as [total analyses – rejected data]/[total analyses]. DEQ-INL OP considers a data usability rate of 90 percent or higher to be acceptable.

[5]Data completeness is calculated as usable results divided by the total number of field sample results expected. DEQ-INL OP considers a data completeness rate of 90 percent or higher to be acceptable.

[6]Radiochemical includes Strontium-90, Technetium-99, Uranium 234, 235, and 238, Plutonium-238, 239/240, Americium-241, and Iodine-129.

**Table 27. Blank analysis results for gross alpha and beta in particulate air (TSP), third quarter, 2022.**

| Collection Period | | Corrected volume ($m^3$)[1] | Gross alpha | | | Gross beta | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | | Value | ± 2 SD | MDC | Value | ±2 SD | MDC |
| 06/29/22 | 07/06/22 | 559 | 0.0 | 0.3 | 0.5 | -0.3 | 0.7 | 1.2 |
| 07/06/22 | 07/13/22 | 559 | 0.0 | 0.3 | 0.5 | 0.7 | 0.6 | 0.9 |
| 07/13/22 | 07/20/22 | 559 | 0.0 | 0.3 | 0.6 | 1.5 | 0.6 | 1.0 |
| 07/20/22 | 07/27/22 | 559 | -0.2 | 0.3 | 0.6 | -0.1 | 0.6 | 1.1 |
| 07/27/22 | 08/03/22 | 559 | -0.5 | 0.3 | 0.7 | -0.1 | 0.7 | 1.2 |
| 08/03/22 | 08/10/22 | 559 | -0.6 | 0.3 | 0.8 | -1.0 | 0.7 | 1.2 |
| 08/10/22 | 08/17/22 | 559 | 0.0 | 0.3 | 0.6 | 0.0 | 0.7 | 1.2 |
| 08/17/22 | 08/24/22 | 559 | 0.1 | 0.3 | 0.5 | 0.3 | 0.7 | 1.2 |
| 08/24/22 | 08/31/22 | 559 | -0.2 | 0.3 | 0.7 | 0.2 | 0.7 | 1.2 |
| 08/31/22 | 09/07/22 | 559 | -0.1 | 0.3 | 0.6 | 0.2 | 0.7 | 1.1 |
| 09/07/22 | 09/14/22 | 559 | 0.0 | 0.3 | 0.6 | 0.6 | 0.7 | 1.1 |
| 09/14/22 | 09/21/22 | 559 | 0.1 | 0.3 | 0.5 | 0.9 | 0.7 | 1.1 |
| 09/21/22 | 09/28/22 | 559 | -0.2 | 0.3 | 0.7 | -0.3 | 0.7 | 1.2 |

Note: Concentrations, associated uncertainties (± 2 SD) and minimum detectable concentrations (MDC) are expressed in 1 x $10^{-3}$ pCi/$m^3$.

[1]A volume equal to the average of the volumes collected through each valid field filter was used to compute "concentrations" for the blank for meaningful comparison to sample results. No air was passed through the blank filters.

**Table 28. Blank analysis results for gamma spectrometry for 47-mm TSP air filters, composite samples, third quarter, 2022.**

| Analysis Date | Beryllium-7 | | | Ruthenium-106/Rhodium-106 | | | Antimony-125 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| 10/17/2022 | -11 | 87 | 150 | -8 | 136 | 242 | 5 | 27 | 45 |

| Analysis Date | Cesium-134 | | | Cesium-137 | | |
|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| 10/17/2022 | -8 | 10 | 17 | 0 | 13 | 22 |

Note: Concentrations are expressed in 1 x $10^{-5}$pCi/$m^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar quarter. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air was actually passed through the blank filters.

**Table 28 (continued). Blank analysis results for gamma spectrometry for 8x10-inch TSP air filters, monthly composite samples, third quarter, 2022.**

| Month | Beryllium-7 | | | Ruthenium-106/Rhodium-106 | | | Antimony-125 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| July 2022 | -39 | 36 | 64 | 5 | 51 | 90 | 0 | 6 | 11 |
| Aug 2022 | 14 | 43 | 72 | -24 | 85 | 149 | 7 | 10 | 17 |
| Sept 2022 | -23 | 69 | 119 | -117 | 148 | 264 | -2 | 15 | 26 |

| Month | Cesium-134 | | | Cesium-137 | | |
|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| July 2022 | -5 | 4 | 7 | 0 | 4 | 7 |
| Aug 2022 | 0 | 4 | 8 | 5 | 5 | 8 |
| Sept 2022 | -1 | 5 | 9 | -2 | 5 | 10 |

Note: Concentrations are expressed in 1 x $10^{-5}$ pCi/$m^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar month. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air was passed through the blank filters.

**Table 29. Blank results for radiochemical analysis of 8x10-inch TSP air filters, quarterly composite samples, second quarter, 2022.**

| Sample Description | $^{90}$Sr | | | $^{238}$Pu | | | $^{239}$Pu/$^{240}$Pu | | | $^{241}$Am | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value[1] | ± 2 SD | MDC | Value[1] | ± 2 SD | MDC | Value[1] | ± 2 SD | MDC | Value[1] | ± 2 SD | MDC |
| Blank | 3.03 | 1.75 | 2.29 | -0.04 | 0.09 | 0.23 | -0.03 | 0.11 | 0.25 | 0.03 | 0.12 | 0.21 |
| Blank recount | 2.49 | 1.62 | 2.30 | - | - | - | - | - | - | - | - | - |

Note: Concentrations are expressed in 1 x $10^{-5}$ pCi/m$^3$ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar quarter. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air was passed through the blank filters.

**Table 30. Blank analysis results for tritium in water vapor from air samples, third quarter, 2022.**

| Sample Number | Start Date | Collection Date | Analysis Date | Tritium | | |
|---|---|---|---|---|---|---|
| | | | | Concentration | ± 2 SD | MDC |
| OP222ZTR03 | 06/30/22 | 07/12/22 | 07/25/22 | 0.01 | 0.09 | 0.16 |
| OP222ZTR04 | 06/30/22 | 07/14/22 | 07/25/22 | 0.03 | 0.09 | 0.15 |
| OP223ZTR01 | 08/10/22 | 08/16/22 | 08/18/22 | 0.16 | 0.10 | 0.16 |
| OP223ZTR02 | 08/10/22 | 08/16/22 | 08/22/22 | 0.03 | 0.09 | 0.16 |
| OP223 FRIDGE | 08/02/22 | 10/11/22 | 10/13/22 | 0.03 | 0.09 | 0.16 |
| OP223 SINK | 08/02/22 | 10/11/22 | 10/13/22 | 0.01 | 0.09 | 0.16 |

Note: Concentrations are expressed in nCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

**Table 31. Blank analysis results (pCi/L) for radiological constituents in water, third quarter, 2022.**

| Sample Number | Sample Date | Blank Type | Concentration | ± 2 SD | MDC | Within Blank Criteria? |
|---|---|---|---|---|---|---|
| **Gross Alpha** | | | | | | |
| 221W597 | 8/15/2022 | Field | 0.2 | 0.3 | 0.4 | Yes |
| **Gross Beta** | | | | | | |
| 221W597 | 8/15/2022 | Field | -1.0 | 0.5 | 1.0 | Yes |
| **Cesium-137** | | | | | | |
| 221W597 | 8/15/2022 | Field | 0.6 | 1.4 | 2.3 | Yes |
| **Tritium (standard method)** | | | | | | |
| 221W598 | 8/15/2022 | Field | 50 | 90 | 160 | Yes |
| **Tritium (low-level method)** | | | | | | |
| 221W442 | 6/21/2022 | Field | 3 | 7 | 12 | Yes |
| 221W447 | 6/15/2022 | Field | 1 | 7 | 11 | Yes |
| 221W487 | 6/28/2022 | Field | -2 | 7 | 12 | Yes |

MDC = minimum detectable concentration.
*Detections in this range are typical of the DI water used by DEQ to prepare blank samples.

**Table 32. Blank analysis results (µg/L) for metals in water, third quarter, 2022.**

| Sample Number | Sample Date | Blank Type | Arsenic | Barium | Chromium | Iron | Lead | Manganese | Selenium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|
| 221W600 | 8/15/2022 | Field | | | <1.0 | | | | - | - |

**Table 33. Blank analysis results (mg/L) for common ions and nutrients in water, third quarter, 2022.**

| Sample Number | Sample Date | Blank Type | Calcium | Magnesium | Sodium | Potassium | Fluoride | Chloride | Sulfate | Alkalinity† | $NO_3$+$NO_2$* | Total Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221W599, 601 | 8/15/2022 | Field | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.4 | <0.8 | <1.0 | <0.01 | - |

†As $CaCO_3$.
*As N.

**Table 34. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, third quarter, 2022.**

| Analysis/Sample Location | Original Sample Number | Concentration | ± 2 SD | Duplicate Sample Number | Concentration | ± 2 SD | RPD | $\lvert R_1-R_2 \rvert$ | $3(S_1^2+S_2^2)^{1/2}$ | Within Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Alpha** | | | | | | | | | | |
| Tan-2336 | 221W509 | -1.3 | 17.2 | 221W501 | 4.0 | 17.8 | 393 | 5.3 | 37.1 | Yes |
| MV-03 | 221W517 | 1.8 | 0.8 | 221W592 | 1.0 | 0.8 | 57 | 0.8 | 1.9 | Yes |
| MV-58 | 221W572 | 0.7 | 0.7 | 221W552 | 0.4 | 0.6 | -55 | 0.3 | 1.4 | Yes |
| **Gross Beta** | | | | | | | | | | |
| Tan-2336 | 221W509 | 885.9 | 38.3 | 221W501 | 868.7 | 37.8 | -2 | 17.2 | 80.7 | Yes |
| MV-03 | 221W517 | 2.5 | 0.8 | 221W592 | 3.5 | 0.8 | -33 | 1.0 | 1.7 | Yes |
| MV-58 | 221W572 | 1.6 | 0.7 | 221W552 | 1.9 | 0.7 | 17 | 0.3 | 1.5 | Yes |
| **Cesium-137** | | | | | | | | | | |
| Tan-2336 | 221W509 | 4.0 | 0.9 | 221W501 | 2.2 | 1.5 | -58 | 1.8 | 2.6 | Yes |
| MV-03 | 221W517 | 0.7 | 1.7 | 221W592 | 2.0 | 0.9 | -96 | 1.3 | 2.9 | Yes |
| MV-58 | 221W572 | -1.5 | 1.8 | 221W552 | 0.2 | 1.7 | 262 | 1.7 | 3.7 | Yes |
| **Tritium (standard method)** | | | | | | | | | | |
| Tan-2336 | 221W511 | 379 | 110 | 221W503 | 253 | 100 | -41 | 130 | 223 | Yes |
| MV-03 | 221W518 | 41 | 90 | 221W593 | 24 | 90 | 67 | 20 | 191 | Yes |
| MV-58 | 221W573 | 11 | 90 | 221W553 | -8 | 90 | 1267 | 20 | 191 | Yes |
| **Tritium (low level method)** | | | | | | | | | | |
| MV-03 | 221W518 | 0 | 8 | 221W593 | -9 | 6 | 200 | 9 | 15 | Yes |
| MV-58 | 221W573 | 4 | 7 | 221W553 | 7 | 7 | 55 | 3 | 15 | Yes |
| **Strontium-90** | | | | | | | | | | |
| TAN-2336 | 221W510 | 327 | 77 | 221W502 | 354 | 83 | 8 | 27 | 170 | Yes |
| **Uranium-234** | | | | | | | | | | |
| TAN-2336 | 221W512 | 0.65 | 0.19 | 221W504 | 0.68 | 0.20 | 5 | 0.03 | 0.41 | Yes |
| **Uranium-235** | | | | | | | | | | |
| TAN-2336 | 221W512 | 0.036 | 0.045 | 221W504 | 0.011 | 0.043 | -106 | 0.025 | 0.093 | Yes |
| **Uranium-238** | | | | | | | | | | |
| TAN-2336 | 221W512 | 0.173 | 0.089 | 221W504 | 0.103 | 0.069 | -51 | 0.070 | 0.169 | Yes |
| **Iodine-129** | | | | | | | | | | |
| USGS-123 | 221W018 | 0.026 | 0.003 | 221W026 | 0.025 | 0.003 | 4 | 0.001 | 0.006 | Yes |

RPD = relative percent difference.

**Table 35. Duplicate results for metals (µg/L) in groundwater, third quarter, 2022.**

| Sample Location | Sample Number | Sample Date | Arsenic | Barium | Chromium | Iron | Lead | Manganese | Selenium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|
| TAN-2336 | 221W506 | 7/12/2022 | 11[2] J | 1000[1] | 130[2] | 9200[1] | <12[2] | 980[1] | - | - |
| TAN-2336 | 221W514 | 7/12/2022 | 11[2] J | 1000[1] | 150[2] | 9300[1] | <12[2] | 980[1] | - | - |
| **RPD** | | | **0** | **0** | **-14** | **-1** | **0** | **0** | **-** | **-** |
| MV-03 | 221W520 | 7/19/2022 | - | - | 2.2 | - | - | - | - | - |
| MV-03 | 221W595 | 7/19/2022 | - | - | 2.1 | - | - | - | - | - |
| **RPD** | | | **-** | **-** | **4.7** | **-** | **-** | **-** | **-** | **-** |
| MV-58 | 221W555 | 7/20/2022 | - | - | 3.3 | - | - | - | - | - |
| MV-58 | 221W575 | 7/20/2022 | - | - | 3.4 | - | - | - | - | - |
| **RPD** | | | **-** | **-** | **3.0** | **-** | **-** | **-** | **-** | **-** |

RPD = relative percent difference.
Data qualifier: J = estimate.
[1]A sample dilution factor of 5 was required for this analysis.
[2]A sample dilution factor of 12.5 was required for this analysis.

**Table 36. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, third quarter, 2022.**

| Sample Location | Sample Number | Sample Date | Calcium | Magnesium | Sodium | Potassium | Fluoride | Chloride | Sulfate | Total Alkalinity† | Total Nitrogen | Total Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAN-2336 | 221W505, 506, 507 | 7/12/2022 | 92[1] | 82[1] | 2600[2] | 17[1] | - | 102[1] | 0.983[1] J | 5700 | 0.10 | 9.7[3] |
| TAN-2336 | 221W513, 514, 515 | 7/12/2022 | 91[1] | 81[1] | 2600[2] | 17[1] | - | 101[1] | 1.05[1] J | 5660 | 0.11 | 9.8[3] |
| **RPD** | | | **2.2** | **1.2** | **0.0** | **0.0** | **-** | **1.0** | **-6.6** | **0.7** | **-9.5** | **-1.0** |
| MV-03 | 221W519, 521 | 7/19/2022 | - | - | - | - | - | 23.0 | 32.1 | 128 | 1.1 | - |
| MV-03 | 221W594, 596 | 7/19/2022 | - | - | - | - | - | 23.1 | 32.1 | 130 | 1.1 | - |
| **RPD** | | | **-** | **-** | **-** | **-** | **-** | **-0.4** | **0.0** | **-1.6** | **0.0** | **-** |
| MV-58 | 221W554, 556 | 7/20/2022 | - | - | - | - | - | 6.95 | 11.0 | 107 | 1.5 | - |
| MV-58 | 221W574, 576 | 7/20/2022 | - | - | - | - | - | 6.96 | 11.1 | 108 | 1.5 | - |
| **RPD** | | | **-** | **-** | **-** | **-** | **-** | **-0.1** | **-0.9** | **-0.9** | **0.0** | **-** |

RPD = relative percent difference.
†As $CaCO_3$.
[1]A sample dilution factor of 5 was required for this analysis.
[2]A sample dilution factor of 25 was required for this analysis.
[3]A sample dilution factor of 50 was required for this analysis.

**Table 37. Duplicate sample results (µg/L) for VOCs in water, third quarter, 2022.**

| Location | Sample Number | Sample Date | PCE | TCE | 1,1-DCE | cis-1,2-DCE | trans-1,2-DCE | Vinyl Chloride | 1,1-DCA | Carbon Tetrachloride | Methylene Chloride | Chloro-methane | 2-Hexanone | Chloro-form | MEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAN-2336 | 221W508 | 7/12/22 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 6.40 | <0.5 | 381 |
| TAN-2336 | 221W516 | 7/12/22 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 9.40 | <0.5 | 335 |
| **RPD** | | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **-38** | **0** | **12.8** |

RPD = relative percent difference.
Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane, MEK = Methyl Ethyl Ketone (2-Butanone).

**Table 38. Duplicate results for soil grab samples, third quarter, third quarter, 2022.**

| Analysis/Sample Location | Original Sample Number | Cs-137 pCi/g | ± 2 SD | Duplicate Sample Number | Cs-137 pCi/g | ± 2 SD | RPD | $\lvert R_1-R_2 \rvert$ | $3(S_1^2+S_2^2)^{1/2}$ | Within Criteria? |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cs-137** | | | | | | | | | | |
| Crystal Ice Caves, 0-5 cm | OP223CICSR01 | 0.34 | 0.10 | OP233CICSR03 | 0.27 | 0.10 | 23 | 0.07 | 0.21 | Yes |
| Crystal Ice Caves, 5-10 cm | OP223CICSR02 | 0.07 | 0.06 | OP223CICSR04 | 0.11 | 0.07 | -44 | 0.04 | 0.14 | Yes |
| Frenchman's Cabin, 0-5 cm | OP223FCSR01 | 0.17 | 0.07 | OP223FCSR03 | 0.14 | 0.07 | 19 | 0.03 | 0.15 | Yes |
| Frenchman's Cabin, 5-10 cm | OP223FCSR02 | 0.01 | 0.05 | OP223FCSR04 | 0.02 | 0.04 | -67 | 0.01 | 0.10 | Yes |
| Reno Ranch, 0-5 cm | OP223RRSR01 | 0.49 | 0.11 | OP223RRSR03 | 0.46 | 0.11 | 6 | 0.03 | 0.23 | Yes |
| Reno Ranch, 5-10 cm | OP223RRSR02 | 0.02 | 0.05 | OP223RRSR04 | 0.05 | 0.05 | -86 | 0.03 | 0.11 | Yes |

**Table 39. ISU-EML electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2022.**

| Electret # | Exposure Received | | Net Measured Exposure[1] | | %R | Within Spec? |
|---|---|---|---|---|---|---|
| | (mR) | Uncertainty (±1 SD, mR) | (mR) | Uncertainty (±1 SD, mR) | | |
| SKR529 | 39.9 | 2.0 | 41.3 | 1.3 | 103.5% | Yes |
| SKR537 | 39.9 | 2.0 | 43.8 | 1.3 | 109.8% | Yes |
| SKR438 | 39.9 | 2.0 | 40.5 | 1.3 | 101.5% | Yes |
| | | | | **Triplicate AVG:** | **104.9%** | **Yes** |
| SMD582 | 30.0 | 1.5 | 28.7 | 1.4 | 95.7% | Yes |
| SKR527 | 30.0 | 1.5 | 28.3 | 1.3 | 94.3% | Yes |
| SKR463 | 30.0 | 1.5 | 29.3 | 1.3 | 97.7% | Yes |
| | | | | **Triplicate AVG:** | **95.9%** | **Yes** |
| SKR566 | 20.0 | 1.0 | 17.4 | 1.3 | 87.0% | Yes |
| SKR532 | 20.0 | 1.0 | 18.8 | 1.3 | 94.0% | Yes |
| SKR441 | 20.0 | 1.0 | 19.7 | 1.3 | 98.5% | Yes |
| | | | | **Triplicate AVG:** | **93.2%** | **Yes** |

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.
[1]Net measured exposure estimate includes a correction for atmospheric pressure.

**Table 40. Air sampling field equipment service reliability (percent operational), third quarter, 2022.**

| Station Locations | Sample Type | | | | |
|---|---|---|---|---|---|
| | 47-mm TSP | 8x10-inch TSP | Radioiodine | Atmospheric Moisture | Precipitation |
| **Onsite Locations** | | | | | |
| Big Lost River Rest Area | 100% | 100% | 100% | 100% | 100% |
| Experimental Field Station | 92% | 92% | 100% | 100% | NC[1] |
| Sand Dunes Tower | 100% | 100% | 100% | 100% | NC[1] |
| Van Buren Avenue | 100% | 100% | 100% | 100% | NC[1] |
| **Boundary Locations** | | | | | |
| Atomic City | 100% | 100% | 100% | 100% | 100% |
| Howe | 100% | 100% | 100% | 100% | 100% |
| Monteview | 100% | 100% | 100% | 100% | 100% |
| Mud Lake | 100% | 100% | 100% | 100% | 100% |
| **Distant Locations[2]** | | | | | |
| Craters of the Moon | 100% | 100% | 100% | 100% | NC[1] |
| Idaho Falls | 100% | 100% | 100% | 100% | 100% |
| Idaho Falls Duplicate[3] | NC[1] | 100% | - | - | - |

Note: The values in this table were calculated by dividing the number of weeks the equipment was in operation by the number of weeks in the quarter.

[1] NC = Sample not collected at this location.

[2] The Fort Hall Station, operated by the Shoshone-Bannock Tribes, is not included here.

[3] A duplicate 8x10-inch filter TSP sampler is currently installed at the Idaho Falls location.

# Appendix A

**Table A-1. Weekly concentrations (in 1 x $10^{-3}$ pCi/$m^3$) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, third quarter, 2022.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **On-Site Locations** | | | | | | |
| **Big Lost River Rest Area** | 06/29/22 | 07/06/22 | 0.9 | 0.4 | 25.9 | 1.5 |
| | 07/06/22 | 07/13/22 | 1.1 | 0.4 | 25.7 | 1.4 |
| | 07/13/22 | 07/20/22 | 2.1 | 0.6 | 27.7 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 1.9 | 0.5 | 32.2 | 1.6 |
| | 07/27/22 | 08/03/22 | 1.5 | 0.6 | 33.6 | 1.7 |
| | 08/03/22 | 08/10/22 | 0.5 | 0.5 | 26.8 | 1.6 |
| | 08/10/22 | 08/17/22 | 1.3 | 0.5 | 25.1 | 1.6 |
| | 08/17/22 | 08/24/22 | 1.8 | 0.5 | 29.7 | 1.5 |
| | 08/24/22 | 08/31/22 | 1.2 | 0.5 | 30.7 | 1.7 |
| | 08/31/22 | 09/07/22 | 2.9 | 0.6 | 30.9 | 1.5 |
| | 09/07/22 | 09/14/22[12] | 2.4 | 0.7 | 32.7 | 1.9 |
| | 09/14/22 | 09/21/22 | 0.8 | 0.4 | 26.4 | 1.5 |
| | 09/21/22 | 09/28/22 | 1.0 | 0.5 | 30.3 | 1.6 |
| **Experimental Field Station** | 06/29/22 | 07/06/22[1] | 1.2 | 0.4 | 24.7 | 1.5 |
| | 07/06/22 | 07/13/22[2] | 0.9 | 0.4 | 24.9 | 1.4 |
| | 07/13/22 | 07/20/22[1] | 1.3 | 0.6 | 23.6 J+ | 1.7 |
| | 07/20/22 | 07/27/22[2] | 1.8 | 0.6 | 31.6 | 1.8 |
| | 07/27/22 | 08/03/22 | 1.4 | 0.5 | 32.7 | 1.6 |
| | 08/03/22 | 08/10/22 | 1.1 | 0.5 | 27.9 | 1.6 |
| | 08/10/22 | 08/17/22 | 1.2 | 0.5 | 21.4 | 1.4 |
| | 08/17/22 | 08/24/22 | 1.7 | 0.5 | 35.9 | 1.7 |
| | 08/24/22 | 08/31/22 | 1.2 | 0.5 | 29.1 | 1.6 |
| | 08/31/22 | 09/07/22[3] | 4.5 | 0.9 | 38.8 | 2.0 |
| | 09/07/22 | 09/14/22 | NS[4] | NS | NS | NS |
| | 09/14/22 | 09/21/22 | 1.1 | 0.5 | 26.5 | 1.6 |
| | 09/21/22 | 09/28/22[3] | 0.5 | 0.6 | 28.5 | 2.0 |
| **Sand Dunes Tower** | 06/29/22 | 07/06/22 | 1.1 | 0.4 | 23.9 | 1.4 |
| | 07/06/22 | 07/13/22 | 1.1 | 0.4 | 25.2 | 1.4 |
| | 07/13/22 | 07/20/22 | 2.2 | 0.6 | 27.2 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 2.6 | 0.6 | 36.3 | 1.7 |
| | 07/27/22 | 08/03/22 | 1.6 | 0.6 | 36.7 | 1.7 |
| | 08/03/22 | 08/10/22 | 0.8 | 0.5 | 31.8 | 1.7 |
| | 08/10/22 | 08/17/22 | 1.4 | 0.5 | 26.1 | 1.5 |
| | 08/17/22 | 08/24/22 | 1.5 | 0.5 | 36.6 | 1.7 |
| | 08/24/22 | 08/31/22 | 1.2 | 0.5 | 31.0 | 1.6 |
| | 08/31/22 | 09/07/22[5] | R[10] | R | R | R |
| | 09/07/22 | 09/14/22 | 3.0 | 0.6 | 33.9 | 1.7 |
| | 09/14/22 | 09/21/22 | 1.2 | 0.4 | 25.0 | 1.4 |
| | 09/21/22 | 09/28/22 | 1.1 | 0.5 | 29.7 | 1.6 |

**Table A-1 continued. Weekly concentrations (in 1 x $10^{-3}$ pCi/$m^3$) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, third quarter, 2022.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Van Buren Avenue** | 06/29/22 | 07/06/22 | 1.1 | 0.4 | 26.1 | 1.5 |
| | 07/06/22 | 07/13/22 | 0.9 | 0.4 | 29.4 | 1.5 |
| | 07/13/22 | 07/20/22 | 1.5 | 0.5 | 26.3 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 1.9 | 0.6 | 35.1 | 1.7 |
| | 07/27/22 | 08/03/22[5] | 1.3 | 0.6 | 34.8 | 1.9 |
| | 08/03/22 | 08/10/22 | R[10] | R | R | R |
| | 08/10/22 | 08/17/22 | 0.2 | 0.3 | 10.7 | 1.1 |
| | 08/17/22 | 08/24/22 | 1.4 | 0.4 | 35.3 | 1.7 |
| | 08/24/22 | 08/31/22 | 1.3 | 0.5 | 29.7 | 1.6 |
| | 08/31/22 | 09/07/22 | 3.7 | 0.7 | 42.4 | 1.9 |
| | 09/07/22 | 09/14/22[13] | 3.6 | 0.8 | 34.8 | 2.0 |
| | 09/14/22 | 09/21/22 | 1.4 | 0.5 | 25.1 | 1.4 |
| | 09/21/22 | 09/28/22 | 1.3 | 0.5 | 33.6 | 1.7 |
| **Boundary Locations** | | | | | | |
| **Atomic City** | 06/29/22 | 07/06/22 | 1.1 | 0.4 | 23.8 | 1.5 |
| | 07/06/22 | 07/13/22 | 1.0 | 0.4 | 26.2 | 1.4 |
| | 07/13/22 | 07/20/22 | 2.6 | 0.6 | 26.3 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 2.4 | 0.6 | 34.6 | 1.7 |
| | 07/27/22 | 08/03/22 | 1.6 | 0.6 | 31.3 | 1.6 |
| | 08/03/22 | 08/10/22 | 0.9 | 0.5 | 30.2 | 1.6 |
| | 08/10/22 | 08/17/22 | 1.0 | 0.4 | 25.0 | 1.5 |
| | 08/17/22 | 08/24/22 | 1.3 | 0.4 | 34.9 | 1.7 |
| | 08/24/22 | 08/31/22 | 1.4 | 0.5 | 29.1 | 1.6 |
| | 08/31/22 | 09/07/22 | 3.5 | 0.6 | 36.5 | 1.7 |
| | 09/07/22 | 09/14/22[5] | 3.4 | 0.6 | 31.3 | 1.5 |
| | 09/14/22 | 09/21/22 | 1.2 | 0.4 | 24.7 | 1.4 |
| | 09/21/22 | 09/28/22 | 1.0 | 0.5 | 30.8 | 1.6 |
| **Howe** | 06/29/22 | 07/06/22[6] | 0.9 | 0.4 | 24.0 | 1.5 |
| | 07/06/22 | 07/13/22[6] | 1.2 | 0.5 | 25.8 | 1.5 |
| | 07/13/22 | 07/20/22[6] | 1.5 | 0.5 | 28.6 J+ | 1.5 |
| | 07/20/22 | 07/27/22[6] | 1.6 | 0.5 | 30.3 | 1.6 |
| | 07/27/22 | 08/03/22[6] | 2.0 | 0.6 | 35.4 | 1.8 |
| | 08/03/22 | 08/10/22[6] | 0.5 | 0.5 | 29.8 | 1.7 |
| | 08/10/22 | 08/17/22[6] | 1.7 | 0.6 | 29.0 | 1.7 |
| | 08/17/22 | 08/24/22[6] | 1.5 | 0.5 | 37.0 | 2.0 |
| | 08/24/22 | 08/31/22 | 1.0 | 0.5 | 27.3 | 1.5 |
| | 08/31/22 | 09/07/22 | 3.8 | 0.7 | 36.9 | 1.7 |
| | 09/07/22 | 09/14/22 | 3.6 | 0.7 | 30.5 | 1.6 |
| | 09/14/22 | 09/21/22 | 0.9 | 0.4 | 25.9 | 1.5 |
| | 09/21/22 | 09/28/22 | 1.0 | 0.5 | 28.5 | 1.5 |

**Table A-1 continued. Weekly concentrations (in 1 x $10^{-3}$ pCi/$m^3$) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, third quarter, 2022.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Monteview** | 06/29/22 | 07/06/22 | 1.0 | 0.4 | 22.5 | 1.5 |
| | 07/06/22 | 07/13/22 | 0.9 | 0.4 | 23.6 | 1.3 |
| | 07/13/22 | 07/20/22 | 1.4 | 0.5 | 23.7 J+ [14] | 1.4 |
| | 07/20/22 | 07/27/22 | 1.7 | 0.5 | 32.0 | 1.6 |
| | 07/27/22 | 08/03/22 | 1.5 | 0.6 | 33.0 | 1.7 |
| | 08/03/22 | 08/10/22 | 0.6 | 0.5 | 30.7 | 1.7 |
| | 08/10/22 | 08/17/22 | 0.9 | 0.4 | 27.0 | 1.5 |
| | 08/17/22 | 08/24/22[5] | 2.3 | 0.9 | 34.8 | 2.7 |
| | 08/24/22 | 08/31/22 | 0.9 | 0.5 | 26.2 | 1.5 |
| | 08/31/22 | 09/07/22[11] | 2.1 | 0.6 | 33.9 | 1.8 |
| | 09/07/22 | 09/14/22 | 3.6 | 0.7 | 31.1 | 1.7 |
| | 09/14/22 | 09/21/22 | 1.1 | 0.4 | 24.1 | 1.3 |
| | 09/21/22 | 09/28/22 | 1.1 | 0.5 | 29.1 | 1.6 |
| **Mud Lake** | 06/29/22 | 07/06/22[6] | 1.6 | 0.5 | 22.5 | 1.4 |
| | 07/06/22 | 07/13/22 | 0.9 | 0.4 | 23.5 | 1.3 |
| | 07/13/22 | 07/20/22 | 1.9 | 0.5 | 26.0 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 1.6 | 0.6 | 36.5 | 1.8 |
| | 07/27/22 | 08/03/22[6] | 1.4 | 0.5 | 31.7 | 1.6 |
| | 08/03/22 | 08/10/22 | 0.4 | 0.5 | 29.7 | 1.7 |
| | 08/10/22 | 08/17/22 | 1.1 | 0.4 | 26.0 | 1.5 |
| | 08/17/22 | 08/24/22 | 1.4 | 0.5 | 36.9 | 1.8 |
| | 08/24/22 | 08/31/22 | 1.6 | 0.5 | 28.2 | 1.6 |
| | 08/31/22 | 09/07/22 | 2.3 | 0.6 | 36.8 | 1.8 |
| | 09/07/22 | 09/14/22 | 2.3 | 0.6 | 29.9 | 1.6 |
| | 09/14/22 | 09/21/22 | 1.1 | 0.4 | 24.1 | 1.4 |
| | 09/21/22 | 09/28/22 | 0.9 | 0.5 | 30.0 | 1.6 |
| **Distant Locations** | | | | | | |
| **Craters of the Moon** | 06/29/22 | 07/06/22[6] | 1.0 | 0.5 | 23.4 | 1.6 |
| | 07/06/22 | 07/13/22 | 1.2 | 0.5 | 25.0 | 1.5 |
| | 07/13/22 | 07/20/22 | 1.2 | 0.5 | 26.0 J+ | 1.5 |
| | 07/20/22 | 07/27/22 | 1.5 | 0.6 | 30.0 | 1.7 |
| | 07/27/22 | 08/03/22 | 1.5 | 0.6 | 30.9 | 1.7 |
| | 08/03/22 | 08/10/22 | 0.5 | 0.5 | 25.0 | 1.6 |
| | 08/10/22 | 08/17/22 | 0.5 | 0.4 | 25.5 | 1.6 |
| | 08/17/22 | 08/24/22 | 1.3 | 0.5 | 35.8 | 1.8 |
| | 08/24/22 | 08/31/22 | 0.7 | 0.5 | 27.6 | 1.7 |
| | 08/31/22 | 09/07/22 | 3.6 | 0.7 | 36.0 | 1.7 |
| | 09/07/22 | 09/14/22 | 3.7 | 0.7 | 29.7 | 1.6 |
| | 09/14/22 | 09/21/22 | 1.3 | 0.4 | 24.9 | 1.4 |
| | 09/21/22 | 09/28/22 | 0.8 | 0.4 | 28.9 | 1.5 |

**Table A-1 continued. Weekly concentrations (in 1 x $10^{-3}$ pCi/$m^3$) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, third quarter, 2022.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Fort Hall**[9] | 06/29/22 | 07/06/22[7] | 0.9 | 0.4 | 16.0 | 1.2 |
| | 07/06/22 | 07/13/22[7] | 0.4 | 0.4 | 11.0 | 1.1 |
| | 07/13/22 | 07/20/22[7] | 0.5 | 0.5 | 7.0 J+ | 1.2 |
| | 07/20/22 | 07/27/22[7] | 0.2 | 0.5 | 1.9 | 1.0 |
| | 07/27/22 | 08/03/22[7,8] | R[10] | R | R | R |
| | 08/03/22 | 08/10/22[7,8] | R[10] | R | R | R |
| | 08/10/22 | 08/17/22[7,8] | R[10] | R | R | R |
| | 08/17/22 | 08/24/22[7,8] | R[10] | R | R | R |
| | 08/24/22 | 08/31/22[7,8] | R[10] | R | R | R |
| | 08/31/22 | 09/07/22[7,8] | R[10] | R | R | R |
| | 09/07/22 | 09/14/22[7] | 2.5 | 0.6 | 32.0 | 1.7 |
| | 09/14/22 | 09/21/22[7] | 1.1 | 0.4 | 25.3 | 1.5 |
| | 09/21/22 | 09/28/22[7] | 1.0 | 0.5 | 27.6 | 1.5 |
| **Idaho Falls** | 06/29/22 | 07/06/22[6] | 1.3 | 0.5 | 22.1 | 1.5 |
| | 07/06/22 | 07/13/22 | 0.9 | 0.4 | 24.6 | 1.4 |
| | 07/13/22 | 07/20/22 | 1.6 | 0.5 | 25.0 J+ | 1.4 |
| | 07/20/22 | 07/27/22 | 1.1 | 0.5 | 31.6 | 1.6 |
| | 07/27/22 | 08/03/22 | 1.1 | 0.5 | 33.6 | 1.7 |
| | 08/03/22 | 08/10/22[6] | 0.3 | 0.5 | 27.0 | 1.6 |
| | 08/10/22 | 08/17/22 | 0.2 | 0.4 | 25.3 | 1.8 |
| | 08/17/22 | 08/24/22 | 1.5 | 0.4 | 32.5 | 1.6 |
| | 08/24/22 | 08/31/22 | 1.2 | 0.5 | 26.8 | 1.5 |
| | 08/31/22 | 09/07/22 | 2.1 | 0.5 | 35.4 | 1.7 |
| | 09/07/22 | 09/14/22 | 2.5 | 0.6 | 35.8 | 1.7 |
| | 09/14/22 | 09/21/22 | 1.0 | 0.4 | 24.8 | 1.4 |
| | 09/21/22 | 09/28/22 | 1.3 | 0.5 | 28.3 | 1.6 |

Note: MDCs typically range from (0.4 to 1.0) x $10^{-3}$ pCi/$m^3$ for gross alpha and from (0.9 to 1.4) x $10^{-3}$ pCi/$m^3$ for gross beta.

[1]EFS power off at filter stop time due to planned power outage. Volume is an estimate based on elapsed time and an assumed constant flow rate of 2.0 cfm. Results are considered (usable) estimates.
[2]EFS power off at filter start time due to planned power outage. Volume is an estimate based on elapsed time and an assumed constant flow rate of 2.0 cfm. Results are considered (usable) estimates.
[3]Partial sample due to a scheduled power outage.
[4]NS – No sample due to a scheduled power outage.
[5]Partial sample.
[6]Faulty rotameter indicated flow rate. Rotameter stop flow rate was > ± 10% error tolerance when compared with a field calibrator. Total volume is an estimate based on elapsed time multiplied by the average of the air flow rate measurements from the air flow calibrator. Results are considered (usable) estimates.
[7]Improper sampling orientation with the filter not fully exposed to the ambient air. Results are considered (usable) estimates.
[8]A dust/dirt clog was discovered 9/6/2022 on the wire screen of the intake tube. Particulates were not allowed to freely flow to the filter.
[9]Operated by Shoshone-Bannock Tribes.
[10]R – Results rejected. Insufficient sample volume for valid analysis.
[11]Partial Sample. New sampler installed midweek. Volume is an estimate. Results are considered (usable) estimates.
[12]Partial sample. New sampling system installed 9/9/22.
[13]Partial sample. New sampling system installed 9/8/22.
[14]The TSP 47-mm filter blank sample gross beta result was greater than its MDC for the week of 7/13/22-7/20/22. All 47-mm TSP gross beta results were qualified as biased-high estimates (J+ flagged) for that week.

# Appendix B

**Table B.1. Results for all electret ionization chamber (EIC) locations, third quarter, 2022.**

| Sample Location | Net Corrected Exposure Rate (µR/hr)[1] | ± 2 SD (µR/hr) |
|---|---|---|
| Arco | 11.7 | 1.7 |
| Craters of the Moon | R[2] | R[2] |
| Big Lost River Rest Area | 15.7 | 4.1 |
| Van Buren Avenue | 13.9 | 4.3 |
| Experimental Field Station | 13.7 | 2.5 |
| Main Gate | 15.5 | 3.6 |
| Atomic City | 14.2 | 2.3 |
| Taber | 15.4, 16.8 | - |
| Blackfoot | 12.7 | 2.1 |
| Ft. Hall | 15.1 | 3.5 |
| Idaho Falls | 11.3 | 3.4 |
| Mud Lake/ Terreton | 12.6, 14.6 | - |
| Monteview | 12.4, 12.4 | - |
| Sand Dunes | 13.6 | 2.5 |
| Howe Met. Tower | 11.6 | 2.9 |
| MP282 -20 | 15.4 | 3.4 |
| MP280 -20 | 13.9 | 2.3 |
| MP278 -20 | 14.9 | 2.7 |
| MP276 -20 | 15.7 | 1.4 |
| MP274 -20 | 11.3 | 4.2 |
| MP272 -20 | 14.1 | 1.7 |
| MP270 -20 | 11.7 | 1.8 |
| MP268 -20 | 16.1 | 4.0 |
| MP266 -20 | 13.2 | 1.6 |
| MP264 -20 | 17.8, 18.1 | - |
| MP270 -20/26 | 17.8 | 3.2 |
| MP268 -20/26 | 14.2 | 1.2 |
| MP266 -20/26 | 13.2, 13.3 | - |
| MP263 -20/26 | 14.2 | 4.1 |
| MP261 -20/26 | 14.6 | 1.8 |
| MP259 -20/26 | 16.3 | 2.5 |
| MP256 -20/26 | 15.7, 17.5 | - |
| MFC (EBR II) | 12.8 | 0.8 |
| EBR I | 13.2 | 0.6 |
| RWMC | 11.3 | 3.8 |
| CFA | 17.8 | 1.7 |
| CITRC (PBF) | 14.3 | 1.6 |
| INTEC | 23.7 | 1.8 |
| ATR (TRA) | 14.3 | 4.0 |
| NRF | 15.1 | 2.4 |
| TAN/SMC | 12.3 | 4.2 |
| Mud Lake Bank of Commerce | 14.1 | 3.2 |
| MP43-33 | 16.3 | 1.9 |
| MP41-33 | 14.7 | 4.7 |
| MP39-33 | 16.9 | 4.6 |

**Table B.1. continued. Results for all electret ionization chamber (EIC) locations, third quarter, 2022.**

| Sample Location | Net Corrected Exposure Rate (µR/hr)[1] | ± 2 SD (µR/hr) |
|---|---|---|
| MP37-33 | 14.8 | 2.0 |
| MP35-33 | 10.9, 11.7 | - |
| MP33-33 | 15.9, 16.8 | - |
| MP31-33 | 14.1 | 4.1 |
| MP29-33 | 16.7 | 4.7 |
| MP27-33 | 16.0 | 3.2 |
| MP25-33 | 12.0 | 1.3 |
| MP23-33 | NS[3] | NS[3] |
| MP21-33 | 12.3 | 2.0 |
| MP19-33 | 12.2, 13.5 | - |
| MP14-33 | 9.9 | 1.6 |
| MP11-33 | 13.5 | 2.1 |
| MP06-33 | 10.8 | 3.8 |
| MP03-33 | 14.6, 16.6 | - |
| Base of Howe | 11.7 | 3.7 |
| Rover | 17.2 | 3.7 |
| Hamer | 16.1 | 1.8 |
| Sugar City | 16.1 | 1.2 |
| Roberts | 13.7 | 3.4 |
| Big Southern Butte | 14.2 | 0.4 |
| T4 North | 17.2 | 3.2 |
| T4 South | 15.5 | 4.6 |

[1]Results are the average of triplicate exposure rate measurements with the associated sample variability (±2 SD), or the 2 measured exposure rates remaining after removal of an outlying value. One of the triplicate measurements is rejected if it is outside the average of the triplicate measurements ±2 SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.
[2]An individual EIC cap was loose/off upon can removal. Wide variation among triplicate exposure rate measurements, with no consistency between pairs of measurements. All results for this location were rejected (R).
[3]NS – No sample. Can holding the EICs was missing on pickup date.

# Appendix C

**Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples.**

| Analyte | Minimum detectable concentrations (MDC) (expressed in µg/L) |
|---|---|
| Benzene | 0.5 |
| Carbon tetrachloride | 0.5 |
| Chlorobenzene | 0.5 |
| 1,4-Dichlorobenzene | 0.5 |
| 1,2-Dichlorobenzene | 0.5 |
| 1,2-Dichloroethane | 0.5 |
| 1,1-Dichloroethene | 0.5 |
| cis-1,2-Dichloroethene | 0.5 |
| trans-1,2-Dichloroethene | 0.5 |
| 1,2-Dichloropropane | 0.5 |
| Ethylbenzene | 0.5 |
| Methylene Chloride | 0.5 |
| Styrene | 0.5 |
| Tetrachloroethene (PCE) | 0.5 |
| Toluene | 0.5 |
| 1,2,4-Trichlorobenzene | 0.5 |
| 1,1,1-Trichloroethane | 0.5 |
| 1,1,2-Trichloroethane | 0.5 |
| Trichloroethylene | 0.5 |
| Vinyl chloride | 0.5 |
| Xylenes (total) | 0.5 |
| Bromodichloromethane | 0.5 |
| Dibromochloromethane | 0.5 |
| Bromoform | 0.5 |
| Chloroform | 0.5 |
| Bromobenzene | 0.5 |
| Bromochloromethane | 0.5 |
| Bromomethane | 0.5 |
| n-Butylbenzene | 0.5 |
| sec-Butylbenzene | 1.0 |
| tert-Butylbenzene | 0.5 |
| Chloroethane | 0.5 |
| Chloromethane | 0.5 |
| 2-Chlorotoluene | 0.5 |

**Table C-1 continued. List of volatile organic compounds (VOCs) analyzed for water samples.**

| Analyte | Minimum detectable concentrations (MDC) (expressed in µg/L) |
|---|---|
| 4-Chlorotoluene | 0.5 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 0.5 |
| 1,2-Dibromoethane (EDB) | 0.5 |
| Dibromomethane | 0.5 |
| 1,3-Dichlorobenzene | 0.5 |
| Dichlorodifluoromethane | 0.5 |
| 1,1-Dichloroethane | 0.5 |
| 1,3-Dichloropropane | 0.5 |
| 2,2-Dichloropropane | 0.5 |
| 1,1-Dichloropropene | 0.5 |
| cis-1,3-Dichloropropene | 0.5 |
| trans-1,3-Dichloropropene | 1.0 |
| Hexachlorobutadiene | 0.5 |
| Isopropylbenzene | 0.5 |
| p-Isopropyltoluene | 0.5 |
| Methyl Ethyl Ketone (MEK) | 10 |
| Methyl Tert Butyl Ether (MTBE) | 0.5 |
| Naphthalene | 0.5 |
| n-Propylbenzene | 0.5 |
| 1,1,1,2-Tetrachloroethane | 0.5 |
| 1,1,2,2-Tetrachloroethane | 0.5 |
| 1,2,3-Trichlorobenzene | 0.5 |
| Trichlorofluoromethane | 0.5 |
| 1,2,3-Trichloropropane | 0.5 |
| 1,2,4-Trimethylbenzene | 1.0 |
| 1,3,5-Trimethylbenzene | 0.5 |