Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT

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Boise Office
1410 N. Hilton
Boise, Idaho 83706
208-373-0428

Idaho Falls Office
900 N. Skyline, Suite B
Idaho Falls, Idaho 83402
208-528-2600

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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 1/1000th 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 second quarter, 2023 (**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. 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 second quarter of 2023 for 47-mm and 8x10-inch TSP filters are presented in **Tables 3** and **4**. For the 47-mm filter composites, the only reported gamma-emitting radionuclide concentration greater than MDC was beryllium-7 (Be-7), a naturally occurring, cosmogenic radionuclide. For the 8x10-inch filter composites, Cs-137 was detected at the Experimental Field Station in the May composite. For the Big Lost River Rest Area 8x10-inch filter May composite, the Cs-137 concentration was equal to the MDC and greater than 3 SD. The result is considered a

questionable detection and J-flagged as an estimate. 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.

Quarterly composites of high-volume 8x10-inch TSP filters are analyzed using radiochemical separation techniques. Results from these composite filter 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 filter composites collected during first quarter 2023 are presented in **Table 5.** There was one Pu-238 detection at Fort Hall for the first quarter of 2023. This result was greater-than-MDC and greater-than-three sample standard deviations. The lower ^{90}Sr MDCs (typically [0.5 – 0.9] x10^{-5} pCi/m^3) reported here for the first quarter 2023 filter composites are from the Eurofins St. Louis laboratory. Previous higher ^{90}Sr MDCs (typically [2 – 6] x10^{-5} pCi/m^3) were from GEL Laboratories LLC.

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 second quarter of 2023.

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**. One or more individual sample atmospheric tritium concentrations exceeded the MDC and 3 SD (sample standard deviations) at Big Lost River Rest Area, Van Buren Avenue, Craters of the Moon, Fort Hall, and Idaho Falls. These individual sample concentrations ranged from 0.40 pCi/m^3 at Craters of the Moon to 1.20 pCi/m^3 at Van Buren Avenue. One individual sample tritium concentration was equal to its MDC and exceeded three SD at Atomic City. All weighted mean concentrations were less than the MDC and 3 SD. 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 second quarter of 2023. 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 was detected in precipitation at Howe for the 06/08/23 – 06/29/23 time period, with the result greater than MDC and greater than 3 SD. There was a questionable tritium detection at Idaho Falls for the time period 03/30/23 – 05/25/23, with the result equal to the MDC and equal to 3 SD. This result was qualified as an estimate (J-flagged). Man-made gamma emitting radionuclides were below minimum detectable concentrations in precipitation collected during the second quarter of 2023. 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**.

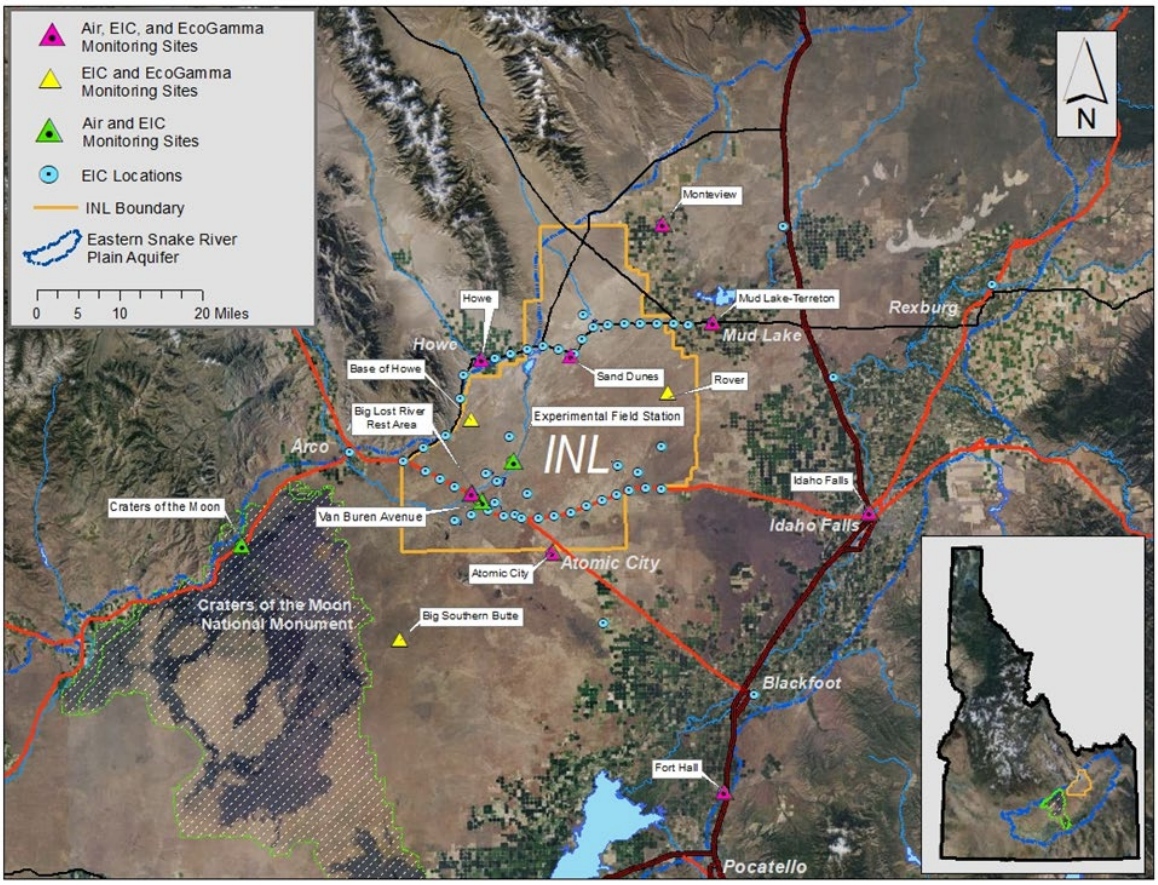

Figure 1. Air and radiation monitoring sites.

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 47-mm TSP filters, second quarter, 2023.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.1	-	1.5	12.4	-	27.5
Experimental Field Station	0.4	-	1.9	12.0	-	28.2
Sand Dunes Tower	0.2	-	1.3	11.0	-	27.1
Van Buren Avenue	0.0	-	1.2	11.2	-	26.4
Boundary Locations						
Atomic City	0.1	-	1.4	12.5	-	25.7
Howe	0.0	-	1.6	14.8	-	30.5
Monteview	0.3	-	1.7	14.4	-	27.0
Mud Lake	0.2	-	1.6	13.5	-	26.9
Distant Locations						
Craters of the Moon	0.1	-	1.5	13.5	-	29.8
Fort Hall[1]	0.1	-	1.4	9.6	-	25.5
Idaho Falls	0.1	-	1.5	13.1	-	26.2

Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.
[1]Operated by Shoshone-Bannock Tribes.

Table 3. Gamma spectroscopy analysis data for 47-mm TSP filters, composite samples, second 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	107.1	6.8	2.5	0.09	0.09	0.15
Experimental Field Station	115.4	6.9	1.8	0.03	0.08	0.13
Sand Dunes Tower	104.3	6.6	1.5	0.01	0.05	0.08
Van Buren Avenue	108.6	6.9	1.4	-0.04	0.05	0.08
Boundary Locations						
Atomic City	110.4	6.8	2.2	0.10	0.09	0.14
Howe	128.9	7.8	2.5	-0.02	0.14	0.24
Monteview	110.8	6.7	1.8	0.00	0.07	0.12
Mud Lake	102.3	6.5	1.5	0.02	0.05	0.08
Distant Locations						
Craters of the Moon	120.7	7.6	1.4	0.00	0.07	0.11
Fort Hall[1]	114.6	6.9	1.8	0.12	0.08	0.13
Idaho Falls	108.2	6.7	2.3	0.01	0.07	0.13

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.

Table 4. Gamma spectrometry analysis data for 8x10-inch TSP filters, monthly composite samples, second quarter, 2023.

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	Apr	99.7	7.2	0.9	0.02	0.04	0.07
	May	156.0	9.0	1.3	0.08 J[7]	0.05 J	0.08 J
	June[6]	122.4 J	7.5 J	0.5 J	-0.01 J	0.02 J	0.04 J
Experimental Field Station	Apr	111.1	6.4	1.5	0.04	0.03	0.06
	May	145.9	8.9	0.8	0.09	0.04	0.06
	June	120.1	6.9	0.9	0.02	0.03	0.05
Sand Dunes Tower	Apr	109.4	6.9	0.7	0.01	0.02	0.03
	May	176.6	10.0	0.9	0.02	0.04	0.06
	June	133.6	8.9	0.7	0.01	0.03	0.05
Van Buren Avenue	Apr	113.7	7.0	0.7	0.00	0.03	0.04
	May	166.9	10.2	0.8	0.03	0.03	0.05
	June	119.0	7.3	0.6	0.00	0.02	0.04
Boundary Locations							
Atomic City	Apr	120.7	6.8	0.8	0.01	0.03	0.05
	May	151.7	8.7	0.9	0.02	0.03	0.05
	June[5]	124.9 J	7.6 J	0.6 J	-0.01 J	0.02 J	0.04 J
Howe	Apr	116.9	7.2	0.6	0.00	0.02	0.04
	May	188.9	10.7	1.0	0.04	0.04	0.07
	June	150.8	10.1	0.6	0.02	0.03	0.04
Monteview	Apr	110.1	6.4	0.8	0.01	0.03	0.05
	May	170.7	10.4	0.9	0.00	0.03	0.05
	June	119.3	6.8	0.9	0.02	0.03	0.05
Mud Lake	Apr	140.8	8.1	1.1	0.04	0.03	0.05
	May	198.8	11.2	1.0	0.05	0.04	0.06
	June	146.7	9.8	0.5	0.02	0.03	0.04
Distant Locations							
Craters of the Moon	Apr	112.6	6.5	1.0	0.02	0.03	0.07
	May	160.8	9.3	1.5	0.05	0.04	0.06
	June	132.2	8.8	0.7	0.02	0.02	0.04
Fort Hall[1]	Apr	156.0	8.8	0.9	0.00	0.03	0.05
	May	178.5	10.2	1.2	0.03	0.04	0.06
	June	153.6	8.7	0.9	0.03	0.03	0.05
Idaho Falls	Apr	144.3	8.2	0.7	-0.02	0.03	0.05
	May	185.4	10.6	0.9	0.03	0.03	0.06
	June	156.1	9.5	0.6	0.01	0.02	0.03
Idaho Falls Duplicate[3]	Apr	138.9	7.9	0.7	0.00	0.04	0.07
	May	157.1	9.0	0.9	-0.02	0.03	0.05
	June	134.2	8.2	0.6	-0.01	0.02	0.03

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 April and May; five filters/composite for June.
[5] Sampler pump failure noted on 6/1/23, with power on but no air flow. Results are considered estimates (J-flagged).
[6] Sampler power was on and flow was indicated on 6/22/23, but there was no air flow. Results are considered estimates (J-flagged).
[7] Concentration is equal to MDC and greater than 3 SD. Result is considered a questionable detection and J-flagged as an estimate.

Table 5. Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during first quarter 2023.

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	0.30	0.44	0.75	0.08	0.11	0.19	0.01	0.03	0.04	-0.02	0.08	0.18
EFS[3]	-0.01	0.40	0.72	0.09	0.12	0.20	0.07	0.07	0.09	0.01	0.08	0.17
Sand Dunes Tower	0.11	0.31	0.53	0.19	0.15	0.21	-0.02	0.04	0.13	0.04	0.09	0.17
Van Buren Avenue	0.07	0.32	0.56	-0.01	0.10	0.20	0.00	0.03	0.08	0.04	0.10	0.18
Boundary Locations												
Atomic City	0.20	0.49	0.84	0.08	0.13	0.22	0.04	0.05	0.08	0.05	0.11	0.20
Howe	0.04	0.49	0.87	0.12	0.11	0.17	0.05	0.05	0.07	0.04	0.07	0.12
Monteview	0.00	0.31	0.56	0.13	0.13	0.20	0.04	0.05	0.08	0.02	0.10	0.20
Mud Lake	-0.11	0.34	0.64	-0.03	0.10	0.23	0.04	0.07	0.11	0.07	0.13	0.23
Distant Locations												
Craters of the Moon	-0.09	0.32	0.61	0.13	0.13	0.19	0.02	0.05	0.11	0.05	0.10	0.18
Fort Hall[2]	0.29	0.41	0.69	0.20	0.13	0.18	0.05	0.06	0.09	-0.02	0.09	0.19
Idaho Falls	0.04	0.36	0.66	0.04	0.09	0.17	0.01	0.04	0.09	0.05	0.09	0.16
Idaho Falls Duplicate[5]	0.16	0.42	0.72	0.08	0.10	0.17	-0.01	0.05	0.14	-0.03	0.09	0.19

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.

Table 6. Iodine-131 activity in weekly charcoal filter composites, second quarter, 2023.

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA[1]
03/30/23	04/06/23	0.81	1.90	3.18
04/06/23	04/13/23	-0.21	1.42	2.45
04/13/23	04/20/23	1.86	2.04	3.34
04/20/23	04/27/23	-0.05	1.67	2.85
04/27/23	05/04/23	-0.58	1.52	2.64
05/04/23	05/11/23	0.28	1.55	2.63
05/11/23	05/18/23	0.39	1.84	3.10
05/18/23	05/25/23	-0.50	1.61	2.79
05/25/23	06/01/23	-1.01	1.64	2.87
06/01/23	06/08/23	-0.25	1.48	2.56
06/08/23	06/14/23	-0.51	2.78	4.70
06/14/23	06/22/23	0.64	3.34	5.60
06/22/23	06/29/23	0.55	1.69	2.84

[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 5.60 pCi/composite is equivalent to a maximum MDC of 9.0 x10^{-4} pCi/m^3.

Table 7. Tritium concentrations in air from atmospheric moisture, second quarter, 2023.

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	03/30/2023	05/04/2023	0.15	0.23	0.38
Big Lost River Rest Area	05/04/2023	05/25/2023	0.24	0.36	0.61
Big Lost River Rest Area	05/25/2023	06/08/2023	0.95	0.48	0.79
Big Lost River Rest Area	06/08/2023	06/29/2023	0.33	0.40	0.66
Big Lost River Rest Area Mean	**03/30/2023**	**06/29/2023**	**0.36**	**0.34**	**0.57**
Experimental Field Station	03/30/2023	04/27/2023	0.18	0.22	0.36
Experimental Field Station	04/27/2023	05/18/2023	0.30	0.30	0.50
Experimental Field Station	05/18/2023	06/01/2023	0.41	0.41	0.68
Experimental Field Station	06/01/2023	06/15/2023	0.65	0.44	0.72
Experimental Field Station	06/15/2023	06/29/2023	0.17	0.34	0.57
Experimental Field Station Mean	**03/30/2023**	**06/29/2023**	**0.32**	**0.32**	**0.54**
Sand Dunes Tower	03/30/2023	05/04/2023	-0.04	0.23	0.38
Sand Dunes Tower	05/04/2023	05/25/2023	0.23	0.33	0.59
Sand Dunes Tower	05/25/2023	06/08/2023	0.63	0.47	0.79
Sand Dunes Tower	06/08/2023	06/29/2023	0.25	0.37	0.62
Sand Dunes Tower Mean	**03/30/2023**	**06/29/2023**	**0.22**	**0.33**	**0.56**
Van Buren Avenue	03/30/2023	05/11/2023	0.20	0.24	0.39
Van Buren Avenue	05/11/2023	06/01/2023	0.46	0.39	0.66
Van Buren Avenue	06/01/2023	06/14/2023	1.20	0.60	0.94
Van Buren Avenue	06/14/2023	06/29/2023	0.29	0.35	0.58
Van Buren Avenue Mean	**03/30/2023**	**06/29/2023**	**0.45**	**0.36**	**0.58**
Boundary Locations					
Atomic City	03/30/2023	05/11/2023	0.42	0.25	0.42
Atomic City	05/11/2023	06/01/2023	0.13	0.33	0.53
Atomic City	06/01/2023	06/29/2023	0.21	0.34	0.55
Atomic City Mean	**03/30/2023**	**06/29/2023**	**0.27**	**0.30**	**0.49**
Howe	03/30/2023	05/04/2023	0.11	0.22	0.36
Howe	05/04/2023	05/25/2023	0.36	0.36	0.60
Howe	05/25/2023	06/08/2023	0.56	0.56	0.89
Howe	06/08/2023	06/29/2023	0.33	0.40	0.67
Howe Mean	**03/30/2023**	**06/29/2023**	**0.30**	**0.35**	**0.58**
Mud Lake	03/30/2023	05/04/2023	0.08	0.24	0.40
Mud Lake	05/04/2023	06/01/2023	0.06	0.37	0.61
Mud Lake	06/01/2023	06/29/2023	0.32	0.48	0.72
Mud Lake Mean	**03/30/2023**	**06/29/2023**	**0.14**	**0.35**	**0.56**
Monteview	03/30/3023	04/27/2023	0.19	0.23	0.38
Monteview	04/27/2023	05/18/2023	0.05	0.30	0.51
Monteview	05/18/2023	06/01/2023	0.23	0.45	0.75
Monteview	06/01/2023	06/14/2023	0.89	0.63	0.98
Monteview	06/14/2023	06/29/2023	0.25	0.38	0.57
Monteview Mean	**03/30/2023**	**06/29/2023**	**0.27**	**0.36**	**0.59**
Distant Locations					
Craters of the Moon	03/30/2023	04/20/2023	0.13	0.19	0.29
Craters of the Moon	04/20/2023	05/04/2023	0.40	0.20	0.33

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
Craters of the Moon	05/04/2023	05/18/2023	0.34	0.29	0.43
Craters of the Moon	05/18/2023	06/01/2023	0.37	0.37	0.61
Craters of the Moon	06/01/2023	06/14/2023	0.69	0.53	0.84
Craters of the Moon	06/14/2023	06/29/2023	0.31	0.31	0.52
Craters of the Moon Mean	**03/30/2023**	**06/29/2023**	**0.34**	**0.30**	**0.47**
Fort Hall[1, 2]	03/30/2023	05/04/2023	0.07 J	0.22 J	0.37 J
Fort Hall	05/04/2023	05/18/2023	0.69	0.35	0.58
Fort Hall	05/18/2023	06/01/2023	0.15	0.45	0.76
Fort Hall	06/01/2023	06/14/2023	0.59	0.51	0.85
Fort Hall	06/14/2023	06/29/2023	0.77	0.39	0.58
Fort Hall Mean	**03/30/2023**	**06/29/2023**	**0.42 J**	**0.36 J**	**0.58 J**
Idaho Falls	03/30/2023	04/27/2023	0.15	0.23	0.38
Idaho Falls	04/27/2023	05/18/2023	0.45	0.30	0.50
Idaho Falls	05/18/2023	06/01/2023	0.43	0.43	0.72
Idaho Falls	06/01/2023	06/14/2023	1.03	0.61	0.95
Idaho Falls	06/14/2023	06/29/2023	0.50	0.38	0.57
Idaho Falls Mean	**03/30/2023**	**06/29/2023**	**0.46**	**0.36**	**0.58**

[1] Operated by Shoshone-Bannock Tribes.
[2] Total air volume was estimated for this sample. Sample results and mean results are qualified as estimates (J).

Table 8. Tritium and gamma-emitting radionuclide concentrations from precipitation, second quarter, 2023.

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	3/30/23	6/8/23	70	60	100	-0.5	1.2	2.1
Big Lost River Rest Area	6/8/23	6/14/23	40	70	110	1.1	1.2	2.0
Big Lost River Rest Area Mean	**3/30/23**	**6/14/23**	**54**	**65**	**105**	**0.4**	**1.2**	**2.0**
Boundary Locations								
Atomic City	03/30/23	06/8/23	30	60	100	1.5	1.7	2.8
Atomic City	06/8/23	06/29/23	30	60	90	0.9	1.1	1.7
Atomic City Mean	**03/30/23**	**06/29/23**	**30**	**60**	**98**	**1.3**	**1.5**	**2.4**
Howe	03/30/23	06/08/23	20	60	100	1.6	1.3	2.1
Howe	06/08/23	06/29/23	100	60	90	-0.7	1.3	2.4
Howe Mean	**03/30/23**	**06/29/23**	**37**	**60**	**98**	**1.1**	**1.3**	**2.2**
Mud Lake	03/30/23	05/25/23	80	60	90	0.0	1.3	2.3
Mud Lake	05/25/23	06/29/23	80	60	90	-1.5	1.4	2.6
Mud Lake Mean	**03/30/23**	**06/29/23**	**80**	**60**	**90**	**-0.5**	**1.3**	**2.4**
Monteview Mean	**03/30/23**	**06/29/23**	**70**	**60**	**90**	**0.3**	**1.4**	**2.5**
Distant Locations								
Idaho Falls	03/30/23	05/25/23	90 J[1]	60 J	90 J	0.8	1.6	2.6
Idaho Falls	05/25/23	06/29/23	50	60	100	1.6	2.0	3.3
Idaho Falls Mean	**03/30/23**	**06/29/23**	**88**	**60**	**91**	**0.8**	**1.6**	**2.6**

Note: Concentrations are reported in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1] Result is equal to the MDC and equal to 3 SD. Result is a questionable detection and qualified as an estimate (J-flagged).

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the second quarter of 2023 (**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 2022. 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 EcoGammas for the second quarter of 2023. **Table 11** lists the EIC monitoring results for the second quarter of 2023. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 9. Summary of instrumentation at radiation monitoring stations.

Station Location	Instrument Type	
	EcoGamma	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, second quarter 2023, from EcoGamma network.

Station Location	Exposure Rate (µR/hr)			
	Quarterly Average*	± 2 SD	Median	Range**
On-site Locations				
Base of Howe	13.1	2.5	13.4	8.6 – 20.4
Big Lost River Rest Area	13.5	2.8	13.9	8.6 – 18.6
Rover	14.4	2.2	14.6	10.1 – 19.4
Sand Dunes Tower	13.8	1.4	13.8	10.7 – 20.3
Boundary Locations				
Atomic City	12.9	2.8	13.3	8.1 – 17.6
Big Southern Butte	12.9	4.2	13.7	7.0 – 18.1
Big Southern Butte duplicate[1]	12.1	3.4	11.3	9.4 – 16.1
Howe Met Tower	12.6	1.2	12.6	10.2 – 15.9
Monteview	12.7	2.2	13.0	8.4 – 18.7
Mud Lake / Terreton	12.8	1.3	12.8	9.6 – 16.5
Distant Locations				
Fort Hall	12.3	1.1	12.3	10.3 – 15.8
Idaho Falls	14.1	1.2	14.1	11.7 – 19.6

*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.
[1] A duplicate EcoGamma was in operation intermittently at Big Southern Butte from 04/19/23 to 04/22/23 and from 06/23/23 to 06/24/23, producing a comparatively small dataset.

Table 11. Electret ionization chamber (EIC) cumulative average exposure rates, second quarter, 2023.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	11.2, 13.2	-
Big Lost River Rest Area	R[2]	R
Experimental Field Station	14.4	4.3
Rover	13.4	3.2
Sand Dunes Tower	13.9	2.5
Van Buren Avenue	11.0, 13.2	-
Boundary Locations		
Atomic City	14.8, 15.9	-
Big Southern Butte	20.0	3.7
Howe Met Tower	11.7	2.5
Monteview	11.2	1.5
Mud Lake/Terreton	9.8, 12.4	-
Distant Locations		
Craters of the Moon	11.0	3.0
Fort Hall	9.5	3.2
Idaho Falls	11.4	1.7

[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]Wide variability among all three EICs was unacceptable. Data from this location was qualified as 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 second quarter of 2023, DEQ-INL OP sampled groundwater from the aquifer at 28 facility locations, 15 boundary locations, 5 distant locations, and 5 upgradient locations. DEQ-INL OP also sampled water from 3 perched well water 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 25** and summarized below. The results of low-level tritium analyses for 13 samples are reported in **Table 16** and discussed below. A backlog of 16 low-level tritium analyses for samples taken during the second quarter of 2023 remains.

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 maximum contaminant level (SMCL). 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.

[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, common ions, metals, nitrate-plus-nitrate, and other constituents are collected along with gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium.

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 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 within background ranges at all locations, except ICPP-MON-A-230. ICPP-MON-A-230 is an aquifer well located at the INTEC facility. Gross alpha activity was detected at a concentration of 6.2 ± 1.4 pCi/L (MDC = 1.3 pCi/L). While this is the highest gross alpha measurement recorded at this location, there is not a statistically significant difference from the 2022 results.

Elevated gross beta activity was measured at TAN, RWMC, and ATR with a maximum of 1288 ± 47 pCi/L (MDC = 33.7 pCi/L) at TAN-2336. Bioremediation efforts are ongoing at the TAN facility, and it is hypothesized that these remediation efforts are mobilizing known ^{90}Sr contamination in the aquifer, resulting in elevated gross beta concentrations. TAN-2271, TAN-28, and TAN-29 also exhibited high gross beta concentrations but were within historical ranges. ICPP-MON-A-230 displayed the highest gross beta concentration at the INTEC facility at 760.3 ± 6.5 pCi/L (MDC = 1.4 pCi/L). This location has known ^{99}Tc contamination and the concentration detected at this well is within the historical range. Other INTEC wells that displayed gross beta concentrations beyond background levels were USGS-052, ICPP-2020, USGS-067, and USGS-047. ATR perched aquifer well USGS-055 had a gross beta concentration of 51.8 ± 2.0 pCi/L (MDC = 1.5 pCi/L), which is within historical ranges. Additionally, ATR perched well USGS-068 exhibited a gross beta concentration of 21.3 ± 2.0 pCi/L (MDC = 2.3 pCi/L). This was the highest concentration measured at this well but is within the historical range when measurement uncertainty is considered. Elevated gross beta concentrations in the perched aquifer below ATR are a result of former disposal wells and percolation ponds at the facility.

Manmade gamma-emitting radionuclides

TAN-2336 was the only location where cesium-137 (^{137}Cs) was detected. Results were 7.3 ± 2.1 pCi/L (MDC = 2.9 pCi/L), which is slightly higher than concentrations in 2022 (4.9 ± 1.8 pCi/L, MDC = 2.6 pCi/L). Ongoing in-situ bioremediation (ISB) for VOCs at TAN cause cation concentrations (calcium, magnesium, sodium, and potassium) to increase. The increase in cations elevates ^{137}Cs and ^{90}Sr concentrations because they are all competing for adsorption sites in the aquifer. As the cation concentrations decrease, it is expected that ^{137}Cs and ^{90}Sr concentrations will also decrease. Results for ^{137}Cs, the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 14**.

Tritium

Tritium was analyzed at all locations sampled this quarter (**Table 15**). Tritium was detected at 23 facility wells, 8 boundary wells, and 1 perched aquifer well using the standard analytical method (typical MDC of 90 to 170 pCi/L). Detected tritium concentrations at the facility wells ranged from 2104 ± 150 pCi/L (MDC = 130 pCi/L) at CFA-1 to 90 ± 60 pCi/L (MDC = 90 pCi/L) at both RWMC wells MS6 and A11A31. Tritium concentrations detected in the boundary wells ranged 615 ± 80 pCi/L (MDC = 100 pCi/L) at USGS-131A (812 ft bgs) to 104 ± 60 pCi/L (MDC = 100 pCi/L) at Middle-

2051_1091. ATR perched aquifer well (USGS-055) had a detection of 1795 ± 140 pCi/L (MDC = 130 pCi/L).

Low-level tritium analysis was performed on six facility wells, four boundary wells, two perched wells, and one upgradient well. The results are reported in **Table 16**. Detections occurred at four facility locations, ranging from 379 ± 11 pCi/L (MDC =7 pCi/L) at RWMC well M7S to 15 ± 4 pCi/L (MDC = 6 pCi/L) at CFA well ICPP-MON-A-166. Concentration at the four boundary locations ranged from 32 ± 4 pCi/L (MDC = 6 pCi/L) at USGS-124 to 10 ± 4 pCi/L (MDC = 6 pCi/L) at Crossroads. Two perched aquifer locations exhibited tritium concentrations of 98 ± 6 pCi/L (MDC = 7 pCi/L) at USGS-068 and 19 ± 5 pCi/L (MDC = 7 pCi/L) at USGS-062. The results from the upgradient site were below the minimum detectable concentration.

All tritium concentrations were consistent with historical data, were measured in areas of known contamination related to INL waste disposal practices, and were all well below the drinking water MCL of 20,000 pCi/L.

Strontium-90

Seventeen aquifer locations and three perched groundwater locations were sampled for ^{90}Sr this quarter (**Table 17**). Detectable concentrations were found in ten aquifer samples at TAN, INTEC, and CFA, with a maximum concentration of 553 ± 46.3 pCi/L (MDC = 1.56) at TAN-2336. Detectable concentrations were also found in three ATR perched groundwater samples, with a maximum of 19.8 ± 1.83 (MDC = 0.28 pCi/L) at USGS-055. Seven locations had ^{90}Sr concentrations that exceeded the MCL of 8 pCi/L. All elevated concentrations were measured in samples from areas of known contamination and are consistent with historical trends.

Technetium-99

Seven facility locations at INTEC and CFA were sampled for ^{99}Tc (**Table 18**). ICPP-MON-A-230 exceeded the MCL for ^{99}Tc (900 pCi/L) with a concentration of 1330 ± 129 (MDC = 2.34 pCi/L). All wells with detections of ^{99}Tc were down gradient of ICPP-MON-A-230.

Plutonium Isotopes
Eight facility wells (INTEC and RWMC) were sampled for plutonium isotopes (^{238}Pu and $^{239/240}Pu$) this quarter (**Table 19**). All wells were non-detections for ^{238}Pu and $^{239/240}Pu$.

Uranium Isotopes

Five TAN, five INTEC, and three RWMC facility wells were sampled for uranium isotopes this quarter (**Table 20**). All wells sampled, with the exception of TAN-2336, yielded detectable results for ^{234}U. The highest concentrations were from TAN-28 at 6.02 ± 0.85 pCi/L (MDC = 0.15 pCi/L) and TAN-29 at 3.78 ± 2.12 pCi/L (MDC = 2.26 pCi/L). Both values were within historical ranges. Detectable concentrations of ^{235}U were found in two wells (TAN-28 at 0.22 ± 0.15 pCi/L, MDC = 0.07 pCi/L and RWMC well M6S at 0.03 ± 0.02 pCi/L, MDC = 0.02 pCi/L). Both were flagged as estimates. Nine locations had detections for ^{238}U this quarter. The maximum ^{238}U concentration was 1.38 ± 0.56 pCi/L (MDC = 0.16 pCi/L) at ICPP-MON-A-230. This is the highest concentration of ^{238}U recorded at this well, but the value is not statistically different from historical results. All detections were consistent with historical data and trends.

Americium Isotopes

Four facility wells (ATR and RWMC) were sampled for americium isotopes (^{241}Am) this quarter (**Table 21**). All wells were non-detections for ^{241}Am.

Common ions, trace metals, and nutrients

Select locations were sampled for common ions (calcium, magnesium, sodium, potassium, chloride, sulfate, and alkalinity), trace metals, (arsenic, barium, chromium, iron, lead, and manganese.) and dissolved nutrients (nitrate-plus-nitrite, phosphorous) (**Tables 22, 23, and 24**).

The highest concentrations of chloride were measured at NRF, TAN, and RWMC. NRF-06 had the highest concentrations at 408 mg/L, which exceed the EPA's secondary MCL of 250 mg/L. Concentrations of barium, arsenic, iron, lead, magnesium, calcium, manganese, sodium, sulfate, alkalinity, potassium, and phosphorous in samples from TAN were elevated above background likely due to ISB conditions, with TAN-2336 measuring the highest concentrations. TAN-28, TAN-29, TAN-2271 and TAN-2336 also exceeded background levels of chloride, with the highest at TAN-2271 (100 mg/L). One perched aquifer well, USGS-068, had elevated background concentrations of chloride at 75.3 mg/L.

TAN-2336 displayed the highest chromium value this quarter, at 310 µg/L. The elevated results are likely the remobilization of chromium due to bioremediation injections. The highest chromium value for perched aquifer wells was 52 µg/L at USGS-062 located east of ATR. This is the largest concentration recorded at this location and may indicate migration of chromium from adjacent perched aquifer wells of similar concentration, such as USGS-068 (50 µg/L). Samples from RWMC well M15S measured a chromium concentration of 62 µg/L, which is a slight increase from 59 µg/L in 2022. Most boundary wells sampled this quarter measured chromium values slightly greater than the background range, with the highest value of 11µg/L at USGS-131A (616 ft bgs).

An arsenic level of 11 µg/L, which is above the MCL (10 µg/L), was measured at ATR perched groundwater well USGS-062. This is a slight increase from 10 µg/L in 2022, but consistent with historical data. All other concentrations were consistent with past observations and trends with most within natural background ranges.

All nutrient results were below the MCL for this quarter. The highest nitrate + nitrite concentration was 9.8 mg/L at perched groundwater well USGS-068 (ATR). These results were a significant decrease from the 2021 results 18 mg/L. One TAN-2336 had elevated levels of phosphorus with 27 mg/L, which is likely a direct result of bioremediation activity. All other concentrations were consistent with past observations and trends with most within natural background ranges.

Volatile organic compounds (VOCs)

VOCs were measured at eight TAN wells and six RWMC wells (**Table 25**). All locations had detectable concentrations of at least one VOC, except for M1S and TAN-2312. Carbon tetrachloride, trichloroethene (TCE), and chloroform continue to be detected at RWMC wells at levels consistent with previous observations. TAN-2336 displayed a methyl ethyl ketone (MEK, 2-butanone) concentration of 2770 µg/L. Detections of MEK most likely represents a side reaction in the bioremediation process and are generally short-lived with a degradation time ranging from 13-128 days (Aronson, Dallas B., and Philip H. Howard. "Anaerobic Biodegradation of Organic Chemicals in Groundwater: A Summary of Field and Laboratory Studies," 1997) .Due to its short-lived nature, there is no immediate threat to

human health and the environment. Concentrations of 2-hexanone at 29.2 µg/L were also observed at TAN-2336. This is the highest level of 2-hexanone detected at this location and will be closely monitored as remediation continues. Tetrachloroethene (PCE), trichloroethene (TCE), trans-1, 2-dichloroethene (trans-1, 2-DCE) and cis-1,2-dichloroethene (cis-1, 2-DCE) continue to be detected at TAN wells; however, notable MCL exceedances and/or changes from previous measurements include:

- TAN-29 TCE = 381 µg/L, down from 458 in 2022 (MCL is 5 µg/L)
- TAN-51 TCE = 239 µg/L, up from 164 in 2022 (MCL is 5 µg/L)
- TAN-44 TCE = 34.2 µg/L, up from 30.8 in 2022 (MCL is 5 µg/L)
- TAN-2271 trans-1, 2-DCE = 64.6 µg/L, up from 2.49 µg/L in 2022 (MCL is 100 µg/L)
- TAN-28 cis-1, 2-DCE = 5.90 µg/L, down from 25.7 µg/L in 2022 (MCL is 70 µg/L)
- TAN-29 PCE = 17.0 µg/L, up from 16.5 µg/L in 2022 (MCL is 5 µg/L)
- TAN-42 TCE = 46.8 µg/L, down from 69.2 µg/L in 2022 (MCL is 5 µg/L)
- TAN-29 cis-1, 2-DCE = 37.6 µg/L, down from 39.5 µg/L in 2022 (MCL is 70 µg/L)
- TAN-29 trans-1, 2-DCE = 9.35 µg/L, up from 8.46 µg/L in 2022 (MCL is 100 µg/L)
- TAN-51 PCE = 25.0 µg/L, down from 26.7 µg/L in 2022 (MCL is 5 µg/L)

All other VOC detections were consistent with historical data and were measured in areas of known contamination.

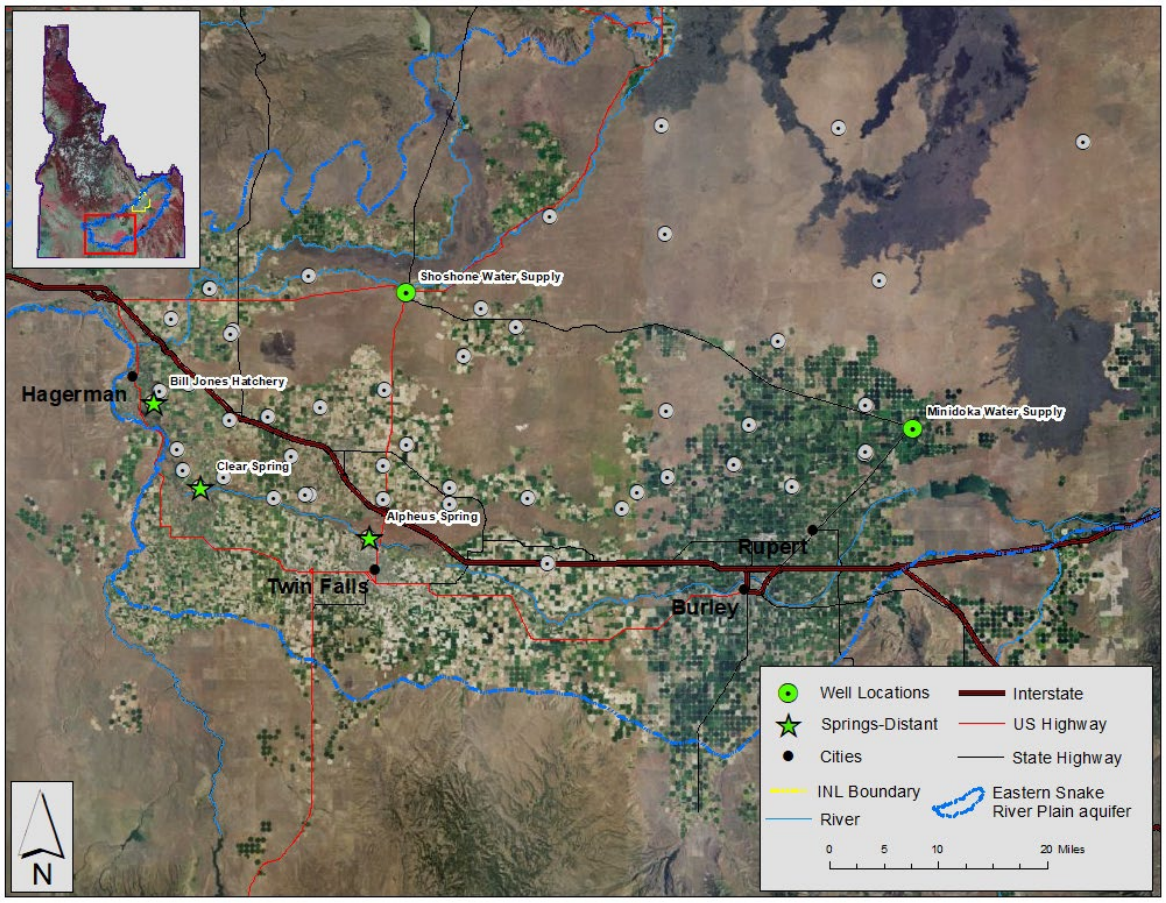

Figure 2. Distant water monitoring locations.

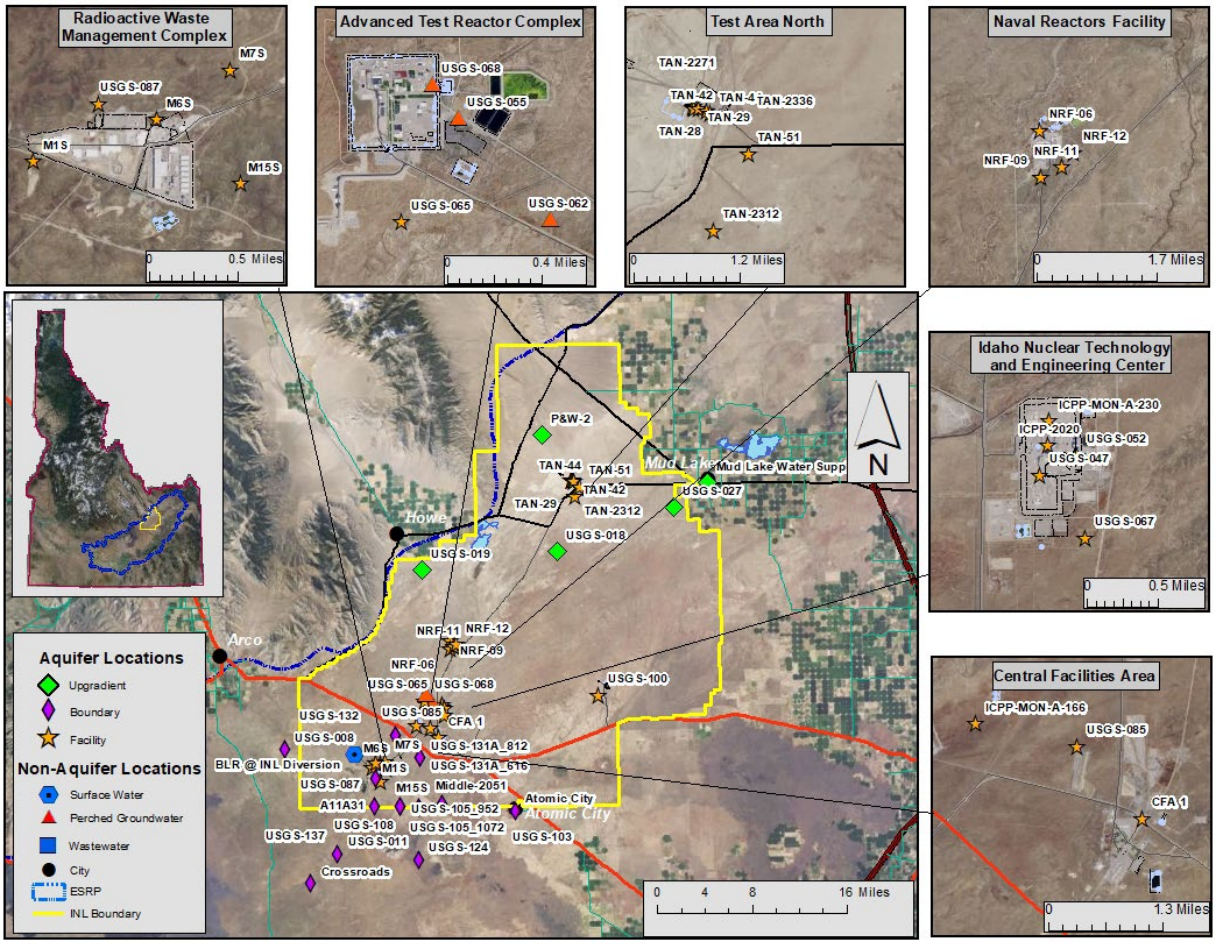

Figure 3. Upgradient, facility, boundary, perched groundwater (GW), surface water and wastewater monitoring locations.

Table 12. Locations sampled in water, second quarter, 2023.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Facility				
Advanced Test Reactor Complex				
USGS-065	04/20/23	USGS	498	α, β, γ, ^{3}H, ^{241}Am, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Idaho Nuclear Technology and Engineering Center				
ICPP-2020	04/03/23	IEC	506	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
ICPP-MON-A-230	04/03/23	IEC	n/a	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-047	04/03/23	IEC	651	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-052	04/26/23	IEC	650	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-067	04/26/23	IEC	694	α, β, γ, ^{3}H, ^{90}Sr, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Radioactive Waste Management Complex				
USGS-087	04/26/23	USGS	673	α, β, γ, ^{3}H, ^{241}Am, U iso, Pu iso, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
M15S	05/02/23	IEC	620	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
M1S	05/02/23	IEC	678	α, β, γ, ^{3}H, U iso, Pu iso, ^{241}Am, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
M6S	05/03/23	IEC	697	α, β, γ, ^{3}H, U iso, Pu iso, ^{241}Am, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
A11A31	05/03/23	IEC	678	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
M7S	05/02/23	IEC	638	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
Test Area North				
TAN-2336	04/25/23	IEC	255	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, P, VOCs
TAN-2271	04/25/23	IEC	289	α, β, γ, ^{3}H, ^{90}Sr, com. ions, trace metals, NO_3+NO_2, VOCs
TAN-28	04/25/23	IEC	262	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, VOCs
TAN-29	04/25/23	IEC	253	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, VOCs
TAN-42	04/25/23	IEC	440	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, P, VOCs
TAN-44	04/25/23	IEC	442	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, VOCs
TAN-2312	06/13/23	IEC	522	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
TAN-51	06/13/23	IEC	470	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, com. ions, trace metals, NO_3+NO_2, VOCs
Central Facilities Area				
CFA 1	04/24/23	USGS	639	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
ICPP-MON-A-166	04/20/23	USGS	527	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-085	04/17/23	USGS	637	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Materials and Fuels Complex				
USGS-100	04/19/23	USGS	750	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Naval Reactors Facility				
NRF-06	05/23/23	USGS	417	α, β, γ, ^{3}H, ^{90}Sr, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
NRF-09	05/23/23	USGS	422	A, β, γ, ^{3}H, ^{90}Sr, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
NRF-11	05/23/23	USGS	417	α, β, γ, ^{3}H, ^{90}Sr, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
NRF-12	05/25/23	USGS	425	α, β, γ, ^{3}H, ^{90}Sr, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Boundary				
Crossroads	05/03/23	USGS	796	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-008	05/03/23	USGS	812	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-011	05/01/23	USGS	704	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-124	05/01/23	USGS	800	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Middle-2051 (749 ft bgs)	06/27/23	USGS	749	α, β, γ, ^{3}H, Cl- SO_4^{2-}, Cr, NO_3+NO_2
Middle-2051 (1091 ft bgs)	06/27/23	USGS	1091	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Atomic City	05/15/23	None	639	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-137A (747 ft bgs)	06/22/23	USGS	747	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-132 (765 ft bgs)	06/14/23	USGS	765	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
USGS-103 (1258 ft bgs)	06/15/23	USGS	1258	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-131A (616 ft bgs)	06/28/23	USGS	616	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-131A (812 ft bgs)	06/28/23	USGS	812	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-105 (952 ft bgs)	06/20/23	USGS	952	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-105 (1072 ft bgs)	06/20/23	USGS	1072	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-108 (1172 ft bgs)	06/26/23	USGS	1172	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Upgradient				
P&W-2	05/02/23	USGS	386	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-018	04/20/23	USGS	329	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-019	05/02/23	USGS	405	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-027	05/02/23	USGS	312	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Mud Lake Water Supply	05/09/23	None	330	α, β, γ, ^{3}H
Distant				
Alpheus Spring	05/08/23	None	n/a	α, β, γ, ^{3}H
Bill Jones Hatchery	05/08/23	None	n/a	α, β, γ, ^{3}H
Clear Spring	05/08/23	None	n/a	α, β, γ, ^{3}H
Minidoka Water Supply	05/08/23	None	282	α, β, γ, ^{3}H
Shoshone Water Supply	05/08/23	None	715	α, β, γ, ^{3}H
Surface Water				
BLR @ INL Diversion	05/31/23	USGS	n/a	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, Cr, NO_3+NO_2
Other Samples				
Perched Groundwater				
Advanced Test Reactor & Radioactive Waste Management Complexes:				
USGS-055	04/24/23	USGS	81	α, β, γ, ^{3}H, ^{90}Sr, com. ions, trace metals, NO_3+NO_2
USGS-062	04/24/23	USGS	165	α, β, γ, ^{3}H, ^{90}Sr, com. ions, trace metals, NO_3+NO_2
USGS-068	04/24/23	USGS	128	α, β, γ, ^{3}H, ^{90}Sr, Cl-, SO_4^{2-}, 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, Pu iso. = plutonium isotopes ^{238}Pu, $^{239/240}$ Pu, Pu; U iso. = uranium isotopes ^{234}U, ^{235}U, ^{238}U; Cl = chloride; 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^-
Phosphorous	<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[f]
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. [f] MCL is for total trihalomethanes.

Table 14. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Advanced Test Reactor Complex										
USGS-065	04/20/23	1.3	J#	0.9	1.8	-	1.0	-0.3	U	1.3
Radioactive Waste Management Complex										
USGS-087	04/26/23	1.1	-	0.8	3.7	-	0.8	1.1	U	1.1
M1S	05/02/23	1.6	-	0.8	4.5	-	0.8	0.1	U	1.7
M6S	05/03/23	2.0	-	0.9	4.1	-	0.8	-0.7	U	1.2
M15S	05/02/23	1.2	U	0.9	6.0	-	0.9	1.4	U	1.3
A11A31	05/03/23	1.0	U	0.8	4.8	-	0.9	-0.3	U	1.6
M7S	05/02/23	1.5	-	0.9	4.7	-	0.9	0.2	U	1.3
Test Area North										
TAN-2271	04/25/23	0.5	U	1.5	670.5	-	8.0	0.9	U	1.4
TAN-28	04/25/23	4.9	-	2.0	384.0	-	6.1	0.7	U	1.2
TAN-2336	04/25/23	-14.6	U	18.1	1288.0	-	47	7.3	-	2.1
TAN-29	04/25/23	4.3	-	1.3	50.3	-	2.0	-0.8	U	1.3
TAN-42	04/25/23	2.2	-	0.9	2.8	J+	0.9	1.3	U	1.9
TAN-44	04/25/23	2.6	-	1.0	5.5	J+	1.0	0.4	U	1.5
TAN-51	06/13/23	1.1	U	0.9	3.2	-	0.9	1.8	U	1.6
TAN-2312	06/13/23	1.3	-	0.8	3.9	-	0.8	-0.3	U	1.2
Central Facilities Area										
USGS-085	04/17/23	1.4	-	0.8	5.0	-	1.0	-0.2	U	1.2
CFA 1	04/24/23	1.8	-	1.0	7.8	-	1.0	1.6	U	1.7
ICPP-MON-A-166	04/20/23	1.6	-	0.8	0.5	U	0.8	0.2	U	1.0
Idaho Nuclear Technology and Engineering Center										
ICPP-MON-A-230	04/03/23	6.2	-	1.4	760.3	-	6.5	-0.3	U	1.3
ICPP-2020	04/03/23	4.5	-	1.3	207.0	-	3.5	0.7	U	1.4
USGS-047	04/03/23	2.9	-	1.0	30.8	-	1.5	1.8	U	1.7
USGS-052	04/26/23	3.4	-	1.1	240.7	-	3.6	0.4	U	1.3
USGS-067	04/26/23	1.9	-	0.9	90.1	-	2.3	0.7	U	1.5
Materials and Fuels Complex										
USGS-100	04/19/23	1.3	-	0.7	2.8	-	0.8	0.6	U	1.2
Naval Reactors Facility										
NRF-06	05/23/23	3.0	U	2.5	9.1	-	2.0	0.2	U	1.4
NRF-09	05/23/23	1.4	U	1.1	2.9	-	1.0	0.5	U	1.3
NRF-11	05/23/23	1.5	U	1.1	2.1	-	0.9	-0.1	U	1.3
NRF-12	05/25/23	1.0	U	1.0	2.5	-	1.0	1.0	U	1.4
Boundary										
USGS-011	05/01/23	1.7	-	0.8	3.0	-	0.8	0.6	U	1.1
USGS-124	05/01/23	1.7	-	0.9	3.6	-	0.8	0.5	U	1.2
USGS-008	05/03/23	2.3	-	1.0	1.9	-	0.8	-0.5	U	1.1
Crossroads	05/03/23	0.9	U	0.8	2.5	-	0.8	0.1	U	1.3
Atomic City	05/15/23	1.2	U	0.9	2.7	-	0.8	0.7	U	2.3
Middle-2051 (1091 ft bgs)	06/27/23	1.8	-	0.9	3.1	-	0.9	-0.3	U	1.1
Middle-2051 (749 ft bgs)	06/27/23	2.9	-	1.0	1.6	-	0.8	0.5	U	1.2
USGS-103 (1258 ft bgs)	06/15/23	0.4	U	0.8	4.7	-	0.9	0.1	U	1.3
USGS-132 (765 ft bgs)	06/14/23	0.8	U	0.8	2.7	-	0.8	-0.8	U	1.3
USGS-137A (747 ft bgs)	06/22/23	2.6	-	1.0	3.2	-	0.9	-0.2	U	1.1
USGS-105 (1072 ft bgs)	06/20/23	1.9	-	0.8	2.9	-	0.8	0.3	U	1.5
USGS-105 (952 ft bgs)	06/20/23	2.2	-	1.0	3.0	-	0.9	1.2	U	1.7
USGS-108 (1172 ft bgs)	06/26/23	1.5	-	0.8	1.7	-	0.8	0.7	U	1.3
USGS-131A (812 ft bgs)	06/28/23	1.9	-	1.0	3.2	-	0.9	3.0	U	1.9
USGS-131A (616 ft bgs)	06/28/23	2.4	-	1.0	3.4	-	0.9	-0.3	U	1.3
Upgradient										

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
USGS-027	05/02/23	5.3	-	1.4	8.2	-	1.1	0.8	U	1.4
P&W-2	05/02/23	2.5	-	0.9	2.2	-	0.8	0.7	U	1.3
USGS-019	05/02/23	2.4	-	0.9	1.9	-	0.8	0.0	U	1.2
USGS-018	04/20/23	2.0	-	0.9	1.1	U	0.9	1.2	U	1.4
Mud Lake Water Supply	05/09/23	0.1	U	0.7	3.3	-	0.8	0.8	U	1.4
Distant										
Alpheus Spring	05/08/23	2.3	-	1.1	8.1	-	1.0	0.1	U	1.2
Clear Spring	05/08/23	1.5	-	0.9	3.6	-	0.8	1.0	U	1.6
Bill Jones Hatchery	05/08/023	1.6	-	0.8	4.8	-	0.8	0.2	U	1.2
Shoshone Water Supply	05/08/23	1.9	-	1.0	2.4	-	0.9	1.0	U	1.2
Minidoka Water Supply	05/08/23	1.1	U	0.9	5.1	-	0.9	0.6	U	1.3
Surface Water										
BLR @ INL Diversion	05/31/23	3.0	-	1.0	2.9	0.8	-	-0.6	U	1.2
Other Samples										
Perched Groundwater										
Advanced Test Reactor & Radioactive Waste Materials Complexes										
USGS-055	04/24/23	1.0	U	0.8	51.8	-	2.0	0.7	U	1.4
USGS-068	04/24/23	2.1	U	1.8	21.3	-	2.0	-0.6	U	1.2
USGS-062	04/24/23	1.2	-	0.8	3.8	-	0.9	-0.9	U	1.5

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 and >2SD but <3SD and is therefore considered questionable and J-flagged as an estimate.
Typical MDC range (gross alpha) 1.0 – 3.8 pCi/L. MDC range (gross beta) 1.1 – 2.8 pCi/L. MDC range (Cs-137) 1.6 – 4.0 pCi/L. MDCs (and 2 SD) for TAN-2336 are higher due to smaller sample aliquants used in the analyses because of high dissolved solids.
*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.
ft bgs = feet below ground surface.

Table 15. Tritium concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Advanced Test Reactor Complex				
USGS-065	04/20/23	1079	-	120
Idaho Nuclear Technology and Engineering Center				
ICPP-MON-A-230	04/03/23	902	-	130
ICPP-2020	04/03/23	1706	-	160
USGS-047	04/03/23	378	-	110
USGS-052	04/26/23	362	-	90
USGS-067	04/26/23	1416	-	130
Radioactive Waste Management Complex				
USGS-087	04/2623	371	-	100
M15S	05/02/23	104	-	60
M1S	05/02/23	-7	U	60
M6S	05/03/23	90	-	60
A11A31	05/03/23	90	-	60
M7S	05/03/23	359	-	60
Test Area North				
TAN-2336	04/25/23	229	-	90
TAN-2271	04/25/23	358	-	100
TAN-28	04/25/23	593	-	110
TAN-29	04/25/23	683	-	110
TAN-42	04/25/23	232	-	90
TAN-44	04/25/23	431	-	100
TAN-2312	06/13/23	34	U	60
TAN-51	06/13/23	335	-	70
Central Facilities Area				
USGS-085	04/41723	668	-	100
CFA 1	04/24/23	2104	-	150
ICPP-MON-A-166	04/20/23	27	U	80
Materials and Fuels Complex				
USGS-100	04/19/23	60	U	80
Naval Reactors Facility				
NRF-06	05/23/23	91	-	60
NRF-09	05/23/23	101	-	60
NRF-11	05/23/23	101	-	60
NRF-12	05/25/23	30	U	60
Boundary				
Crossroads	05/03/23	13	U	80
USGS-008	05/03/23	24	U	80
USGS-011	05/01/23	-17	U	90
USGS-124	05/01/23	0	U	90
Middle-2051 (749 ft bgs)	06/27/23	160	-	60
Middle-2051 (1091 ft bgs)	06/27/23	104	-	60
Atomic City	05/15/23	65	U	60
USGS-137A (747 ft bgs)	06/22/23	81	U	70
USGS-132 (765 ft bgs)	06/14/23	125	-	60
USGS-103 (1258 ft bgs)	06/15/23	119	-	60
USGS-131A (616 ft bgs)	06/28/23	613	-	70
USGS-131A (812 ft bgs)	06/28/23	615	-	80
USGS-105 (952 ft bgs)	06/20/23	162	-	60
USGS-105 (1075 ft bgs)	06/20/23	150	-	60
USGS-108 (1172 ft bgs)	06/26/23	46	U	60
Upgradient				
P&W-2	05/02/23	-50	U	80
USGS-018	04/20/23	20	U	80

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
USGS-019	05/02/23	-3	U	80
USGS-027	05/02/23	41	U	60
Mud Lake Water Supply	05/09/23	-59	U	90
Distant				
Alpheus Spring	05/08/23	-23	U	90
Bill Jones Hatchery	05/08/23	-26	U	100
Clear Spring	05/08/23	-13	U	90
Minidoka Water Supply	05/08/23	-40	U	90
Shoshone Water Supply	05/08/23	-59	U	80
Surface Water				
BLR @ INL Diversion	05/31/23	81	U	60
Other Samples				
Perched Groundwater				
Advanced Test Reactor & Radioactive Waste Management Complexes				
USGS-055	04/24/23	1795	-	140
USGS-062	04/24/23	37	U	90
USGS-068	04/24/23	67	U	80

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 90 - 170 pCi/L.

Table 16. Low-level tritium concentrations (pCi/L) in water samples collected during 2023 and analyzed using the electrolytic enrichment method, second quarter, 2023.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Radioactive Waste Management Complex				
M15S	05/02/23	52	-	5
A11A31	05/03/23	64	-	5
M1S	05/02/23	0	U	4
M6S	05/03/23	3	U	5
M7S	05/02/23	379	-	11
Central Facilities Area				
ICPP-MON-A-166	04/20/23	15	-	4
Boundary				
Crossroads	05/03/23	10	-	4
USGS-008	05/03/23	13	-	4
USGS-011	05/01/23	18	-	5
USGS-124	05/01/23	32	-	4
Upgradient				
USGS-019	05/02/23	3	U	4
Other Samples				
Perched Groundwater				
Advanced Test Reactor				
USGS-068	04/13/22	98	-	6
USGS-062	04/24/23	19	-	5

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 - 8 pCi/L.

Table 17. Strontium-90 concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Test Area North				
TAN-2271	04/25/23	269	-	22
TAN-2336	04/25/23	553	-	46
TAN-28	04/25/23	148	-	12
TAN-29	04/25/23	14.6	-	1.4
TAN-42	04/25/23	-0.01	U	0.18
TAN-44	04/25/23	0.04	U	0.18
Idaho Nuclear Technology and Engineering Center				
ICPP-MON-A-230	04/03/23	2.36	-	0.66
ICPP-2020	04/03/23	7.71	-	1.10
USGS-047	04/03/23	15.7	-	1.7
USGS-052	04/26/23	1.4	-	0.3
USGS-067	04/26/23	9.3	-	1.0
Central Facilities Area				
USGS-085	04/17/23	1.25	-	0.27
CFA 1	04/24/23	-0.21	U	0.18
Naval Reactors Facility				
NRF-06	05/23/23	0.07	U	0.17
NRF-09	05/23/23	0.13	U	0.18
NRF-11	05/23/23	0.19	U	0.17
NRF-12	05/25/23	0.10	U	0.17
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex				
USGS-068	04/24/23	5.51	-	0.65
USGS-062	04/24/23	0.42	-	0.23
USGS-055	04/24/23	19.8	-	1.8

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively. MDCs (and 2 SD) for TAN-2336 are higher due to smaller sample aliquants used in the analyses because of high dissolved solids.
MDC range 0.17 – 22.3 pCi/L.

Table 18. Technetium-99 concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Aquifer Samples				
Facility				
Central Facilities Area				
USGS-085	04/17/23	0.51	U	0.51
CFA 1	04/24/23	6.03	-	0.86
Idaho Nuclear Technology and Engineering Center				
ICPP-MON-A-230	04/03/23	2.3	U	4.8
ICPP-2020	04/03/23	286	-	28
USGS-047	04/03/23	0.04	U	0.50
USGS-052	04/26/23	379	-	37
USGS-067	04/26/23	105	-	10

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 0.84 – 2.34 pCi/L.

Table 19. Plutonium isotope concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240		
		Concentration		2 SD	Concentration		2 SD
Aquifer Samples							
Facility							
Idaho Nuclear Technology and Engineering Center							
ICPP-MON-A-230	04/23/23	0.06	U	0.09	0.00	U	0.04
ICPP-2020	04/23/23	0.00	U	0.01	0.00	U	0.01
USGS-047	04/23/23	0.02	U	0.07	0.00	U	0.08
USGS-052	04/26/23	-0.02	U	0.07	-0.02	U	0.04
USGS-067	04/26/23	0.05	U	0.12	0.00	U	0.05
Radioactive Waste Management Complex							
USGS-087	04/26/23	0.11	U	0.32	-0.07	U	0.10
M1S	05/02/23	0.04	U	0.07	0.02	U	0.03
M6S	05/03/23	0.05	U	0.07	0.03	U	0.03

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 (Pu-238) 0.01 – 0.56 pCi/l. MDC range (Pu-239/240) 0.01 – 0.27 pCi/L.

Table 20. Uranium isotope concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Test Area North										
TAN-28	04/25/23	6.02	-	0.85	0.22	J#	0.15	1.14	-	0.31
TAN-2336	04/25/23	0.47	U	0.77	0.17	U	0.71	0.67	U	0.94
TAN-29	04/25/23	3.78	-	2.12	-0.14	U	0.20	0.53	U	0.96
TAN-42	04/25/23	1.97	-	0.29	0.05	U	0.04	0.80	-	0.17
TAN-44	04/25/23	1.77	-	0.54	0.12	U	0.16	0.88	-	0.37
Idaho Nuclear Technology and Engineering Center										
ICPP-MON-A-230	04/03/23	2.54	-	0.77	-0.01	U	0.16	1.38	-	0.56
ICPP-2020	04/03/23 10:05:00	2.62	-	1.07	0.25	U	0.36	0.84	J#	0.63
USGS-047	04/03/23 11:20:00	1.89	-	0.36	0.05	U	0.07	0.67	-	0.24
USGS-067	04/26/23	1.50	-	0.56	-0.02	U	0.03	0.79	-	0.41
USGS-052	04/26/23	1.83	-	1.03	0.0	U	0.08	0.34	U	0.48
Radioactive Waste Management Complex										
USGS-087	04/26/23	1.15	-	0.62	-0.02	U	0.05	0.79	-	0.49
M1S	05/02/23	0.98	-	0.20	-0.00	U	0.04	0.39	-	0.11
M6S	05/03/23	1.99	-	0.17	0.03	J#	0.02	0.05	U*	0.11

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.
#Result is >MDC and >2SD but <3SD and is therefore considered questionable and J-flagged as an estimate.
MDC range (U-234) 0.09 – 2.26 pCi/L. MDC range (U-235) 0.02 – 1.60 pCi/L. MDC range (U-238) 0.03 – 1.72 pCi/L.

Table 21. Americium isotope concentrations (pCi/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Americium-241		
		Concentration		2 SD
Aquifer Samples				
Facility				
Advanced Test Reactor				
USGS-065	04/20/23	0.021	U	0.026
Radioactive Waste Management Complex				
USGS-087	04/26/23	0.021	U	0.026
M1S	05/02/23	-0.027	U	0.055
M6S	05/03/23	-0.004	U	0.051

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 0.04 – 0.11 pCi/L.

Table 22. Common ion concentrations (mg/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Chloride		Sulfate		Alkalinity†	
Aquifer Samples															
Facility															
Idaho Nuclear Technology and Engineering Center															
ICPP_2020	04/03/23	-	-	-	-	-	-	-	-	59.4[2]	-	33.9	-	136	
ICPP-MON-A-230	04/03/23	-	-	-	-	-	-	-	-	66.2[2]	-	32.8	-	133	
USGS-047	04/03/23	-	-	-	-	-	-	-	-	14.5	-	21.3	-	144	
USGS-067	04/26/23	-	-	-	-	-	-	-	-	37.0[3]	-	27.2	-	135	
USGS-052	04/26/23									20.5	-	24.4	-	143	
Advanced Test Reactor															
USGS-065	04/20/23	-		-	-	-	-	-	-	19.4	-	140[2]	-	132	-
Test Area North															
TAN-2336	04/25/23	75[2]	-	120[2]	-	5000[4]	-	22[2]	-	72[1]	-	2.36[1]	UJ	1080	-
TAN-2271	04/25/23	54	J	45	-	97	-	7.5	-	100[2]	-	37.6	-	434	-
TAN-28	04/25/23	85	-	37	-	67	-	5.8	-	90.2[2]	-	34.3	-	412	-
TAN-29	04/25/23	62	-	18	-	47	-	4.7	-	75.5[2]	-	37.6	-	215	-
TAN-42	04/25/23	54	-	15	-	17	-	2.9	-	43.2[4]	-	34.0	-	156	-
TAN-44	04/25/23	60	-	16	-	22	-	3.1	-	62.7[2]	-	35.6	-	154	-
TAN-2312	06/13/23	-	-	-	-		-		-	8.94	-	26.6	-	125	-
TAN-51	06/13/23	52	-	15	-	7.4	-	3.1	-	34.5	-	31.7	-	130	-
Central Facilities Area															
USGS-085	04/17/23	-	-	-	-	-	-	-	-	12.6	-	40.6	-	152	-
CFA 1	04/24/23	-	-	-	-	-	-	-	-	64.7[2]	-	31.6	-	132	-
ICPP-MON-A-166	04/20/23	-	-	-	-	-	-	-	-	19.6	-	19.4	-	122	-
Naval Reactors Facility															
NRF-06	05/23/23	-	-	-	-	-	-	-	-	408[1]	-	78.2[1]	-	175	-
NRF-09	05/23/23	-	-	-	-	-	-	-	-	54.4[3]	-	42.5	-	193	-
NRF-11	05/23/23	-	-	-	-	-	-	-	-	40.6[3]	-	38.7	-	194	-
NRF-12	05/25/23	-	-	-	-	-	-	-	-	39.7[3]	-	39.3	-	194	-
Radioactive Waste Management Complex															
USGS-087	04/26/23	-	-	-	-	-	-	-	-	26.3	-	27.4	-	123	-
M1S	05/02/23	-	-	-	-	-	-	-	-	13.3	-	22.0	-	93.0	-
M6S	05/03/23	-	-	-	-	-	-	-	-	28.6	-	62.9	-	96.0	-
M15S	05/02/23	-	-	-	-	-	-	-	-	78.4[2]	-	44.1	-	90.0	-
A11A31	05/03/23	-	-	-	-	-	-	-	-	31.6	-	53.6	-	132	-
M7S	05/02/23	-	-	-	-	-	-	-	-	14.7	-	25.7	-	141	-
Materials and Fuels Complex															
USGS-100	04/19/23	-	-	-	-	-	-	-	-	15.3	-	16.8	-	131	-
Boundary															
Crossroads	05/03/23	-	-	-	-	-	-	-	-	10.1	-	22.2	-	138	-
USGS-008	05/03/23	-	-	-	-	-	-	-	-	7.86	-	23.1	-	153	-
USGS-011	05/01/23	-	-	-	-	-	-	-	-	9.39	-	23.4	-	139	-
USGS-124	05/01/23	-	-	-	-	-	-	-	-	16.7	-	24.8	-	140	-
Middle-2051 (749 ft bgs)	06/27/23	-	-	-	-	-	-	-	-	11.4	-	26.4	-	148	-
Middle-2051 (1091 ft bgs)	06/27/23	-	-	-	-	-	-	-	-	12.0	-	24.3	-	144	-
Atomic City	05/15/23	-	-	-	-	-	-	-	-	17.0	-	18.0	-	133	-
USGS-137A (747 ft bgs)	06/22/23		-							10.3	-	17.8	-	118	-
USGS-132 (765 ft bgs)	06/14/23	-	-	-	-	-	-	-	-	11.5	-	26.5	-	144	-
USGS-103 (1258 ft bgs)	06/15/23	-	-	-	-	-	-	-	-	12.1	-	18.7	-	118	-
USGS-131A (616 ft bgs)	06/28/23	-	-	-	-	-	-	-	-	19.0	-	25.5	-	137	-
USGS-131A (812 ft bgs)	06/28/23	-	-	-	-	-	-	-	-	23.6	-	28.8	-	149	-

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Chloride		Sulfate		Alkalinity†	
USGS-105 (952 ft bgs)	06/20/23	-	-	-	-	-	-	-	-	11.5	-	20.9	-	126	-
USGS-105 (1075 ft bgs)	06/20/23	-	-	-	-	-	-	-	-	10.0	-	18.7	-	113	-
USGS-108 (1172 ft bgs)	06/26/23	-	-	-	-	-	-	-	-	14.4	-	19.8	-	129	-
Upgradient															
P&W-2	05/02/23	-		-	-	-	-	-	-	8.93		31.0	-	140	-
USGS-018	04/20/23	-		-	-	-	-	-	-	11.7		26.3	-	133	-
USGS-019	05/02/23	-		-	-	-	-	-	-	11.9		23.7	-	157	-
USGS-027	05/02/23	-		-	-	-	-	-	-	45.8[2]		39.9	-	158	-
Surface Water															
BLR @ INL Diversion	05/31/23	-	-	-	-	-	-	-	-	2.69		16.0	-	195	-
Other Samples															
Perched Groundwater															
Advanced Test Reactor															
USGS-055	04/24/23	50	-	15	-	12	-	2.6	-	12.6	-	46.9	-	163	-
USGS-062	04/24/23	50	-	16	-	11	-	2.8	-	12.2	-	52.4	-	158	-
USGS-068	04/24/23	-	-	-	-	-	-	-	-	75.3[2]	-	333[2]	-	196	-

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 $CaCO_3$.
"-" = not analyzed.
Note 1. Lab indicated that a 20:1 dilution of this sample was required for this analyte. Note 2. Lab indicated that a 5:1 dilution of this sample was required for this analyte. Note 3. Lab indicated that a 2:1 dilution of this sample was required for this analyte. Note 4. Lab indicated that a 50:1 dilution of this sample was required for this analyte.

Table 23. Dissolved metals concentrations (µg/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese	
Aquifer Samples													
Facility													
Advanced Test Reactor													
USGS-065	04/20/23	-	-	-	-	79		-	-	-	-	-	-
Idaho Nuclear Technology and Engineering Center													
ICPP-MON-A-230	04/03/23	-	-	-	-	5.6	-	-	-	-	-	-	-
ICPP-2020	04/03/23	-	-	-	-	8.2	-	-	-	-	-	-	-
USGS-047	04/03/23	-	-	-	-	7.0	-	-	-	-	-	-	-
USGS-067	04/26/23	-	-	-	-	6.9	-	-	-	-	-	-	-
USGS-052	04/26/23	-	-	-	-	7.2	-	-	-	-	-	-	-
Radioactive Waste Management Complex													
USGS-087	04/26/23	-	-	-	-	7.4	-	-	-	-	-	-	-
M1S	05/02/23	-	-	-	-	37	-	-	-	-	-	-	-
M6S	05/03/23	-	-	-	-	36	-	-	-	-	-	-	-
M15S	05/02/23	-	-	-	-	62	-	-	-	-	-	-	-
A11A31	05/03/23	-	-	-	-	14	-	-	-	-	-	-	-
M7S	05/02/23	-	-	-	-	10	-	-	-	-	-	-	-
Test Area North													
TAN-2336	04/25/23	19[3]	-	2000[3]	-	310[3]	-	8800[3]	-	<1.0	UJ	670[3]	-
TAN-2271	04/25/23	1.4	UJ	580[1]	-	1.6	-	2500	-	<1.0	U	990[1]	-
TAN-28	04/25/23	1.6	UJ	370[2]	-	1.9	-	3200	-	<1.0	U	2000[2]	-
TAN-29	04/25/23	1.8	UJ	200[3]	-	1.1	-	5.0	UJ	<1.0	U	62	-
TAN-42	04/25/23	2.1	-	150	-	5.7	-	7.0	UJ	<1.0	U	0.78	UJ
TAN-44	04/25/23	2.1	-	180	-	4.1	-	<10	U	<1.0	U	2.2	-
TAN-2312	06/13/23	-	-	-	-	6.8	-	-	-	-	-	-	-
TAN-51	06/13/23	1.9	UJ	93	-	4.8	-	<10	U	0.16	UJ	<1.0	U
Central Facilities Area													
USGS-085	04/17/23	-	-	-	-	18	-	-	-	-	-	-	-

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese	
CFA 1	04/24/23	-	-	-	-	12	-	-	-	-	-	-	-
ICPP-MON-A-166	04/20/23	-	-	-	-	4.4	-	-	-	-	-	-	-
Materials and Fuels Complex													
USGS-100	04/19/23	-	-	-	-	2.8	-	-	-	-	-	-	-
Naval Reactors Facility													
NRF-06	05/23/23	-	-	-	-	96	-	-	-	-	-	-	-
NRF-09	05/23/23	-	-	-	-	12	-	-	-	-	-	-	-
NRF-11	05/23/23	-	-	-	-	12	-	-	-	-	-	-	-
NRF-12	05/25/23	-	-	-	-	9.6	-	-	-	-	-	-	-
Boundary													
Crossroads	05/03/23	-	-	-	-	4.1		-	-	-	-	-	-
USGS-008	05/03/23	-	-	-	-	3.1	-	-	-	-	-	-	-
USGS-011	05/01/23	-	-	-	-	4.0	-	-	-	-	-	-	-
USGS-124	05/01/23	-	-	-	-	5.8	-	-	-	-	-	-	-
Middle-2051 (749 ft bgs)	06/15/22	-	-	-	-	6.8	-	-	-	-	-	-	-
Middle-2051 (1091 ft bgs)	06/15/22	-	-	-	-	6.6	-	-	-	-	-	-	-
Atomic City	05/15/23	-	-	-	-	2.4	-	-	-	-	-	-	-
USGS-137A (747 ft bgs)	06/22/23	-	-	-	-	4.5	-	-	-	-		-	-
USGS-132 (765 ft bgs)	06/14/23	-	-	-	-	7.7	-	-	-	-	-	-	-
USGS-103 (1258 ft bgs)	06/15/23	-	-	-	-	2.4	-	-	-	-	-	-	-
USGS-131A (616 ft bgs)	06/28/23	-	-	-	-	11	-	-	-	-	-	-	-
USGS-131A (812 ft bgs)	06/28/23	-	-	-	-	10	-	-	-	-	-	-	-
USGS-105 (952 ft bgs)	06/20/23	-	-	-	-	6.4	-	-	-	-	-	-	-
USGS-105 (1075 ft bgs)	06/20/23	-	-	-	-	5.6	-	-	-	-	-	-	-
USGS-108 (1172 ft bgs)	06/26/23	-	-	-	-	4.3	-	-	-	-	-	-	-
Upgradient													
P&W-2	05/02/23	-	-	-	-	2.0		-	-	-	-	-	-
USGS-018	04/20/23	-	-	-	-	3.0		-	-	-	-	-	-
USGS-019	05/02/23	-	-	-	-	1.6		-	-	-	-	-	-
USGS-027	05/02/23	-	-	-	-	5.4		-	-	-	-	-	-
Surface Water													
BLR @ INL Diversion	05/31/23	-	-	-	-	0.45	UJ	-	-	-	-	-	-
Other Samples													
Perched Groundwater													
Advanced Test Reactor & Radioactive Waste Management Complexes													
USGS-068	04/24/23	-	-	-	-	50	-	-	-	-	-	-	-
USGS-062	04/24/23	11	-	2	-	52	-	-	-	-	-	-	-
USGS-055	04/24/23	7.7	-	2	-	49	-	-	-	-	-	-	-

Note 1. Lab indicated that a 10:1 dilution of this sample was required for this analyte. Note 2. Lab indicated that a 20:1 dilution of this sample was required for this analyte. Note 3. Lab indicated that a 5:1 dilution of this sample was required for this analyte.

Table 24. Dissolved nutrient concentrations (mg/L) in water samples, second quarter, 2023.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
Advanced Test Reactor Complex					
USGS-065	04/20/23	1.4	-	-	-
Idaho Nuclear Technology and Engineering Center					
ICPP-2020	04/03/23	6.2[4]	-	-	-
ICPP-MON-A-230	04/03/23	7.1[5]	-	-	-
USGS-047	04/03/23	2.0[2]	-	-	-
USGS-052	04/26/23	2.0	-	-	-
USGS-067	04/26/23	5.0[4]	-	-	-
Radioactive Waste Management Complex					
USGS-087	04/26/23	0.71	-	-	-
M1S	05/02/23	1.1[2]	-	-	-
M6S	05/03/23	2.0[2]	-	-	-
M15S	05/02/23	1.5	-	-	-
A11A31	05/03/23	1.0	-	-	-
M7S	05/05/23	0.82	-	-	-
Test Area North					
TAN-2336	04/25/23	0.20	-	27.0[1]	-
TAN-2271	04/25/23	<0.010	UJ	-	-
TAN-28	04/25/23	0.01	-	-	-
TAN-29	04/25/23	2.5[2]	-	-	
TAN-42	04/25/23	1.4	-	0.03	-
TAN-44	04/25/23	2.1[2]	-	-	-
TAN-47	04/03/23	2.0[2]	-	-	-
TAN-2312	06/13/23	0.74	-	-	-
TAN-51	06/13/23	1.2	-	-	-
Central Facilities Area					
USGS-085	04/17/23	0.95	-	-	-
CFA 1	04/24/23	2.4[3]	-	-	-
ICPP-MON-A-166	04/20/23	0.32	-	-	-
Materials and Fuels Complex					
USGS-100	04/19/23	2.4[2]	-	-	-
Naval Reactors Facility					
NRF-06	05/23/23	2.2[3]	J+	-	-
NRF-09	05/23/23	3.1[2]	J+	-	-
NRF-11	05/23/23	2.3[2]	J+	-	-
NRF-12	05/25/23	2.2[2]	J+	-	-
Boundary					
Crossroads	05/03/23	0.76	-	-	-
USGS-008	05/03/23	1.0	-	-	-
USGS-011	05/01/23	0.76	-	-	-
USGS-124	05/01/23	0.87	-	-	-
Middle-2051 (749 ft bgs)	06/27/23	0.84	-	-	-
Middle-2051 (1091 ft bgs)	06/27/23	0.90	-	-	-
Atomic City	05/15/23	1.7	-	-	-
USGS-137A (747 ft bgs)	06/22/23	0.56	-	-	-
USGS-132 (765 ft bgs)	06/14/23	0.75	-	-	-
USGS-103 (1258 ft bgs)	06/15/23	0.66	-	-	-
USGS-131A (616 ft bgs)	06/28/23	0.96	-	-	-
USGS-131A (812 ft bgs)	06/28/23	1.2	-	-	-
USGS-105 (952 ft bgs)	06/20/23	0.70	-	-	-
USGS-105 (1075 ft bgs)	06/20/23	0.57	-	-	-
USGS-108 (1172 ft bgs)	06/26/23	0.81	-	-	-
Upgradient					
USGS-027	05/02/23	2.5[2]	-	-	-
P&W-2	05/02/23	0.52	-	-	-

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
USGS-019	05/02/23	0.98	-	-	-
USGS-018	04/20/23	0.64	-	-	-
Surface Water					
BLR @ INL Diversion	05/31/23	0.09	-	-	-
Other Samples					
Perched Groundwater					
Advanced Test Reactor & Radioactive Waste Management Complexes					
USGS-055	04/24/23	1.1	-	-	-
USGS-068	04/24/23	9.8[5]	-	-	-
USGS-062	04/24/23	1.1	-	-	-

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. ft bgs = feet below ground surface.
* As N.
"-" = not analyzed.
Note 1. Lab indicated that a 100:1 dilution of this sample was required for this analyte. Note 2. Lab indicated that a 2:1 dilution of this sample was required for this analyte. Note 3. Lab indicated that a 4:1 dilution of this sample was required for this analyte. Note 4. Lab indicated that a 5:1 dilution of this sample was required for this analyte. Note 5. Lab indicated that a 10:1 dilution of this sample was required for this analyte.

Table 25. Volatile organic compound concentrations (µg/L) in water samples, second quarter, 2023. 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		2-Hexanone	
Aquifer Samples																	
Facility																	
Radioactive Waste Management Complex																	
USGS-087	04/26/23	<0.5	U	1.23	-	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
M1S	05/02/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
M6S	05/03/23	<0.5	U	0.92	-	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
M15S	05/02/23	0.53	-	4.32	-	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
A11A31	05/03/23	0.21	UJ	2.03	-	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
M7S	05/02/23	0.47	UJ	2.39	-	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
Test Area North																	
TAN-2336	04/25/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	29.2[3]	-
TAN-2271	04/25/23	<0.5	U	0.98	-	<0.5	U	1.18	-	64.6[3]	-	1.53	-	<0.5	U	<0.5	U
TAN-28	04/25/23	<0.5	U	1.97	-	<0.5	U	5.90	-	65.0[3]	-	6.22	-	<0.5	U	<0.5	U
TAN-29	04/25/23	17.0	-	381[4]	-	0.69	-	37.6	-	9.35	-	0.56	-	<0.5	U	<0.5	U
TAN-42	04/25/23	6.94	-	46.8[2]	-	0.27	UJ	2.08	-	0.73	-	<0.5	U	<0.5	U	<0.5	U
TAN-44	04/25/23	3.26	-	34.2	-	<0.5	U	0.93	-	0.56	-	<0.5	U	<0.5	U	<0.5	U
TAN-51	06/13/23	25.0	-	239[1]	-	0.59	-	4.05	-	1.16	J+	<0.5	U	<0.5	U	<0.5	U
TAN-2312	06/13/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U

Table 25 cont. Volatile organic compound concentrations (µg/L) in water samples, second quarter, 2023. Only VOCs detected this quarter or in the recent past are shown.

Sample Location	Sample Date	Carbon Tetrachloride		Chloroform		Chloro-ethane		1,1-DCA		Carbon Disulfide		Methyl Ethyl Ketone	
Radioactive Waste Management Complex													
USGS-087	04/26/23	3.92	-	0.32	UJ	<0.5	U	<0.5	U	<0.5	U	<10	U
M1S	05/03/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U
M6S	05/03/23	3.16	-	0.42	UJ	<0.5	U	<0.5	U	<0.5	U	<10	U
M15S	05/02/23	6.77	-	2.40	-	<0.5	U	<0.5	U	<0.5	U	<10	U
A11A31	05/03/23	3.62	-	0.80	-	<0.5	U	<0.5	U	<0.5	U	<10	U
M7S	05/02/23	4.17	-	0.88	-	<0.5	U	<0.5	U	<0.5	U	<10	U
Test Area North													
TAN-2336	04/25/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	2770[3]	-
TAN-2271	04/25/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U
TAN-28	04/25/23	<0.5	U	<0.5	U	0.46	UJ	0.40	UJ	<0.5		<10	U
TAN-29	04/25/23	<0.5	U	0.35	UJ	<0.5	U	0.78	-	<0.5	U	<10	U
TAN-42	04/25/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U
TAN-44	04/25/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U
TAN-51	06/13/23	<0.5	U	0.33	UJ	<0.5	U	<0.5	U	<0.5	U	<10	U
TAN-2312	06/13/23	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U

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.

Note 1. Lab indicated that a 10:1 dilution of this sample was required for this analyte. Note 2. Lab indicated that a 2:1 dilution of this sample was required for this analyte. Note 3. Lab indicated that a 5:1 dilution of this sample was required for this analyte. Note 4. Lab indicated that a 20:1 dilution of this sample was required for this analyte.

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. No i*n-situ* gamma spectroscopic measurements of soil were performed during the second calendar quarter of 2023, and no physical soil samples were collected during the quarter. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. Twelve milk samples were analyzed during the quarter.

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 26**. ^{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 26. Gamma spectrometry analysis data for milk samples, second quarter, 2023.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131		
		Concentration[2]	± 2 SD	Concentration[2]	± 2 SD	MDC
Monitoring Samples						
Gooding	04/19/23	1433	117	-1.6	1.7	2.9
Gooding	05/23/23	1437	114	1.0	2.7	4.4
Gooding	06/20/23	1447	118	1.1	2.6	4.4
Monteview	04/17/23	1386	109	0.7	2.6	4.4
Monteview	05/11/23	1346	112	0.1	4.8	8.2
Monteview	06/06/23	1442	105	0.5	1.7	2.9
Tetonia	04/06/23	1414	111	0.3	1.4	2.4
Tetonia	05/06/23	1395	116	1.9	2.4	4.0
Tetonia	06/24/23	1483	116	0.2	1.8	3.1
Verification Samples[1]						
Dietrich	04/19/23	1337	108	0.6	1.5	2.5
Terreton	05/16/23	1369	113	0.1	1.7	2.8
Dietrich	06/14/23	1505	121	0.3	1.5	2.6

[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.

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 second quarter of 2023. 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 second quarter of 2023, DEQ-INL OP submitted 129 QC samples for various radiological and non-radiological analyses (**Table 27**).

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 second quarter of 2023 are presented in **Table 28**. Blank sample results for selected gamma emitters in air from 47-mm TSP filter quarterly composites and 8x10-inch monthly composites are presented in **Table 29**. Blank sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from first quarter 2023 are presented in **Table 30.** Data for blank analyses used to assess data quality for

[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).

tritium in water vapor in air are presented in **Table 31**. Blank sample results for radiological constituents in water are presented in **Table 32**. Blank sample results for metals, common ions and nutrients, and VOCs are presented in **Tables 33, 34, and 35.** A field blank water sample gross beta result was greater than MDC on 4/25/23. Associated field sample gross beta results from TAN wells TAN-42 and 44 are qualified as biased-high estimates (flagged J+). A field blank water sample $NO_3 + NO_2$ result was greater than MDC on 5/23/23. Associated field sample $NO_3 + NO_2$ results from NRF wells NRF-06, 09, 11, and 12 are qualified as biased-high estimates (flagged J+).

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 are 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 36**. Duplicate results for metals, common ions and nutrients, and VOCs in groundwater are presented in **Tables 37, 38,** and **39.** Duplicate gross beta results for the Minidoka Water Supply sample minimally exceeded the three times pooled error acceptance criterion. No samples were qualified as a result of this exceedance.

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).

Spiked water samples were analyzed for metals, common ions and nutrients, and VOCs. Results are presented in **Tables 40, 41, and 42.** For the 5/9/23 VOC spike sample, the percent recoveries for trans-1,2-dichloroethene and methylene chloride were unacceptably high at 128% and 151% respectively, and the percent recovery for styrene was low at 71%. All other spiked sample results were acceptable. For the 4/5/23 spike all analytes were within acceptable limits. Methylene chloride and styrene were not detected in field samples. The trans-1,2-dichloroethene original result and duplicate result from the TAN-51 sample taken on 6/13/23 were qualified as biased-high estimates (J+) based on the high 5/9/23 spike result.

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 second quarter 2023 are presented in **Table 43**. 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 in the second quarter of 2023.

DEQ-INL OP Equipment QC Issue

There were no DEQ-INL OP Equipment QC issues in the second quarter of 2023.

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 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 second quarter of 2023 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 12.9% is acceptable and above the DEQ-INL OP minimum requirement of 10%. Methodologies and data reports issued by the contracting laboratories conformed to the requirements of DEQ-INL OP during the second quarter of 2023.

[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 99.9% for the second quarter of 2023 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 27**. The overall data completeness (usable results divided by the total number of field sample results expected) of 99.8% 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 second quarter of 2023 is summarized in **Table 44**.

Conclusion

All data collected for the second quarter of 2023 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 99.9% and data completeness of 99.8% 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 27. Summary of the analyses performed, second quarter, 2023.

Media Sampled	Collection Device	Analyte	Sample Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected[1]	Analyzing Lab[2]
Air								
Total Suspended Particulate	47-mm filters	Gross alpha	143	13	0	0	0	ISU-EML
		Gross beta	143	13	0	0	0	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
	8x10-inch filter	Gamma emitters	36	3	0	0	0	ISU-EML
		Radiochemical[6]:						
		Sr-90	12	1	0	0	0	ISU-Sub
		Pu-238, 239/240	12	1	0	0	0	ISU-Sub
		Am-241	12	1	0	0	0	ISU-Sub
Water Vapor	Desiccant column	Tritium	48	6	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	11	0	0	0	0	ISU-EML
		Gamma emitters	11	0	0	0	0	ISU-EML
Water								
Ground water, perched ground water, waste pond effluent, and surface water	Grab or composite	Gross alpha	57	4	6	0	0	ISU-EML
		Gross beta	57	4	6	0	0	ISU-EML
		Gamma emitters	57	4	6	0	0	ISU-EML
		Tritium	57	4	6	0	0	ISU-EML
		Low-level tritium	13	1	1	0	0	ISU-EML
		Radiochemical[7]:						
		Sr-90	20	2	1	0	0	ISU-Sub
		Tc-99	7	0	1	0	0	ISU-Sub
		U-234, 235,238	13	1	1	0	0	ISU-Sub
		Pu-238, 239/240	8	0	1	0	0	ISU-Sub
		Am-241	4	0	0	0	0	ISU-Sub
		I-129	0	0	0	0	0	ISU-Sub
		Metals	51	4	5	1	0	IBL
		Common Ions	51	4	5	1	0	IBL
		Nutrients	51	4	5	1	0	IBL
		Volatile Organics	14	2	2	2	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	12	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	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			**1001**	**73**	**42**	**14**	**1**	
Total QC analyses performed (blanks, duplicates, and spikes)			**129**					
Ratio of total QC analyses to total sample analyses[3]			**12.9%**					
Data usability[4], percent			**99.9%**					
Data completeness[5], percent			**99.8%**					

[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 analyses for these filter composites include Strontium-90 (Sr-90), Plutonium-238 and 239/240 (Pu-238, 239/240), and Americium-241 (Am-241).
[7] Radiochemical analyses for these water samples may include Strontium-90, Technetium-99 (Tc-99), Uranium 234, 235, and 238 (U-234, 235, 238), Plutonium-238 and 239/240, Americium-241, and Iodine-129 (I-129).

Table 28. Blank analysis results for gross alpha and beta in 47-mm particulate air (TSP), second quarter, 2023.

Collection Period		Corrected volume (m^3)[1]	Gross alpha			Gross beta		
Start	Stop		Value	± 2 SD	MDC	Value	±2 SD	MDC
03/30/23	04/06/23	558	0.0	0.3	0.6	-0.4	0.5	1.0
04/06/23	04/13/23	558	-0.4	0.3	0.6	0.1	0.6	1.0
04/13/23	04/20/23	558	-0.1	0.3	0.5	-0.3	0.5	1.0
04/20/23	04/27/23	558	-0.2	0.3	0.6	-0.2	0.6	1.0
04/27/23	05/04/23	558	0.0	0.3	0.5	-0.3	0.6	1.0
05/04/23	05/11/23	558	-0.2	0.3	0.6	-1.1	0.6	1.1
05/11/23	05/18/23	558	-0.1	0.3	0.5	-0.2	0.5	0.9
05/18/23	05/25/23	558	-0.2	0.3	0.6	-1.0	0.6	1.0
05/25/23	06/01/23	558	-0.1	0.3	0.6	-0.3	0.6	1.0
06/01/23	06/08/23	558	-0.2	0.3	0.6	0.7	0.5	0.9
06/08/23	06/14/23	558	0.0	0.3	0.5	0.1	0.5	0.9
06/14/23	06/22/23	558	0.1	0.3	0.5	0.0	0.6	1.0
06/22/23	06/29/23	558	0.2	0.3	0.5	-0.4	0.6	1.1

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 weekly 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 29. Blank results for gamma spectrometry analysis of monthly composites of 8x10-inch TSP air filters, and quarterly composites of 47-mm TSP air filters, second quarter, 2023.

Time period	Beryllium-7			Ruthenium-106/ Rhodium-106			Antimony-125			Cesium-134			Cesium-137		
	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC
Monthly composites[1] of 8x10-inch TSP air filters															
Apr	1	20	33	-11	39	70	3	8	14	-2	3	5	0	3	5
May	-1	15	26	-19	50	89	1	8	14	0	3	5	1	2	4
June	-9	19	33	-1	47	82	1	6	9	-2	4	7	1	2	4
Quarterly composite[2] of 47-mm TSP air filters															
2nd Qtr.	-1	38	66	-36	172	297	-6	18	32	-4	7	12	-4	6	10

Note: Concentrations (Conc) are expressed in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]These concentrations (Conc)are from blank 8x10-inch filters collected weekly, composited, and analyzed for the calendar month. [2]These concentrations are from blank 47-mm 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 30. Blank results for radiochemical analysis of 8x10-inch TSP air filters, quarterly composite samples, first quarter, 2023.

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	0.31	0.28	0.45	0.09	0.11	0.18	0.04	0.06	0.10	0.03	0.08	0.15

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 31. Blank analysis results for tritium in water vapor from air samples, second quarter, 2023.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP232ZTR01	05/30/23	06/01/23	06/22/23	-0.05	0.06	0.10
OP232ZTR02	06/05/23	06/07/23	07/05/23	0.06	0.06	0.10
OP232ZTR03	07/20/23	07/24/23	08/18/23	0.08	0.06	0.09
OP232ZTR04	07/24/23	07/28/23	08/18/23	0.04	0.06	0.09
Control OP232 Fridge	05/03/23	06/29/23	07/21/23	0.01	0.06	0.10
Control OP232 Sink	05/03/23	06/29/23	07/21/23	0.02	0.06	0.10

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

Table 32. Blank analysis results (pCi/L) for radiological constituents in water, second quarter, 2023.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
231W134	4/20/2023	Field	0.2	0.2	0.3	Yes
231W220	4/25/2023	Field	0.0	0.2	0.3	Yes
231W379	5/23/2023	Field	0.3	0.2	0.3	Yes
231W477	6/20/2023	Field	0.3	0.2	0.3	Yes
Gross Beta						
231W134	4/20/2023	Field	-0.4	0.5	0.9	Yes
231W220	4/25/2023	Field	1.0	0.5	0.8	No
231W379	5/23/2023	Field	-0.2	0.6	1.0	Yes
231W477	6/20/2023	Field	0.5	0.6	0.9	Yes
Cesium-137						
231W134	4/20/2023	Field	1.0	1.9	3.2	Yes
231W220	4/25/2023	Field	-0.6	1.9	2.1	Yes
231W379	5/23/2023	Field	0.2	1.4	2.4	Yes
231W477	6/20/2023	Field	-0.2	1.5	2.5	Yes
Tritium (standard method)						
231W135	4/20/2023	Field	-20	90	150	Yes
231W222	4/25/2023	Field	-40	80	140	Yes
231W381	5/23/2023	Field	60	60	90	Yes
231W478	6/20/2023	Field	10	60	100	Yes
Tritium (low-level method)						
231W135	4/20/2023	Field	-3	4	7	Yes
Strontium-90						
231W221	4/25/2023	Field	-0.064	0.151	0.287	Yes
231W380	5/23/2023	Field	-0.097	0.198	0.373	Yes
Uranium-234						
231W223	4/25/2023	Field	0.000	0.390	0.943	Yes
Uranium-235						
231W223	4/25/2023	Field	-0.0626	0.0887	0.701	Yes
Uranium-238						
231W223	4/25/2023	Field	0.251	0.356	0.562	Yes

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

Table 33. Blank analysis results (µg/L) for metals in water, second quarter, 2023.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
231W137	04/20/2023	Field	-	-	<1.0	-	-	-	-	-
231W225	04/25/2023	Field	<2.0	<1.0	<1.0	<10	<1.0	<1.0		
231W383	05/23/2023	Field	-	-	<1.0	-	-	-	-	-
231W480	06/20/2023	Field	-	-	<1.0	-	-	-	-	-

Table 34. Blank analysis results (mg/L) for common ions and nutrients in water, second quarter, 2023.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity†	NO_3+NO_2*	Total Phosphorus
231W136, 138	04/20/2023	Field	-	-	-	-	-	<0.4	<0.8	<1.0	<0.01	-
231W224, 225, 226	04/25/2023	Field	<0.10	<0.10	<0.10	<0.10	-	<0.4	<0.8	<1.0	<0.01	-
231W382, 384	05/23/2023	Field	-	-	-	-	-	<0.4	<0.8	<1.0	0.16	-
231W479, 481	06/20/2023	Field	-	-	-	-	-	<0.4	<0.8	<1.0	<0.01	-

† As $CaCO_3$.

* As N.

Table 35. Blank analysis results (µg/L) for VOCs in water, second quarter, 2023.

Sample Number	Sample Date	Blank Type	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	1,1-DCA	Carbon Tetrachloride	Methylene Chloride	Chloro-form	Chloro-methane	MEK
231W227	4/25/2023	Field	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10
231W326	4/26/2023	Field	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10

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

Table 36. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, second quarter, 2023.

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 either criterion?
Gross Alpha										
USGS-047	231W050	3.4	1.0	231W080	1.8	0.8	62	1.6	1.9	Yes
USGS-011	231W255	1.7	0.8	231W279	1.8	0.8	-6	0.1	1.7	Yes
M7S	231W314	1.5	0.9	231W320	1.9	1.0	-24	0.4	2.0	Yes
Minidoka Water Supply	231W333	1.1	0.9	231W339	0.5	1.0	75	0.6	2.0	Yes
Atomic City	231W345	1.2	0.9	231W350	1.7	1.0	-34	0.5	2.0	Yes
TAN-51	231W415	1.1	0.9	231W421	2.3	1.0	-71	1.2	2.0	Yes
Gross Beta										
USGS-047	231W050	30.8	1.5	231W080	32.5	1.5	-5	1.7	3.2	Yes
USGS-011	231W255	3.0	0.8	231W279	3.4	0.8	-13	0.4	1.7	Yes
M7S	231W314	4.7	0.9	231W320	5.0	0.9	-6	0.3	1.9	Yes
Minidoka Water Supply	231W333	5.1	0.9	231W339	3.1	0.9	49	2.0	1.9	No
Atomic City	231W345	2.7	0.8	231W350	2.5	0.8	8	0.2	1.7	Yes
TAN-51	231W415	3.2	0.9	231W421	4.4	0.8	-32	1.2	1.8	Yes
Cesium-137										
USGS-047	231W050	1.8	1.7	231W080	0.5	1.4	113	1.3	3.3	Yes
USGS-011	231W255	0.6	1.1	231W279	0.1	1.1	143	0.5	2.3	Yes
M7S	231W314	0.2	1.3	231W320	1.3	1.6	-147	1.1	3.1	Yes
Minidoka Water Supply	231W333	0.6	1.3	231W339	1.3	1.2	-74	0.7	2.6	Yes
Atomic City	231W345	0.7	2.3	231W350	0.8	1.2	-13	0.1	3.9	Yes
TAN-51	231W415	1.8	1.6	231W421	-0.8	1.4	520	2.6	3.2	Yes
Tritium (standard method)										
USGS-047	231W056	380	110	231W085	340	100	11	40	223	Yes
USGS-011	231W256	-20	90	231W280	50	60	-467	70	162	Yes
M7S	231W315	360	60	231W321	420	60	-15	60	127	Yes
Minidoka Water Supply	231W334	-40	90	231W340	-90	80	-77	50	181	Yes
Atomic City	231W346	65	60	231W351	14	60	129	51	127	Yes
TAN-51	231W416	340	70	231W422	280	70	19	60	148	Yes
Tritium (low level method)										
USGS-011	231W256	18	2.5	231W280	16	2.5	12	2	11	Yes
Strontium-90										
USGS-047	231W054	15.7	1.7	231W083	15.1	1.8	4	0.6	3.7	Yes
Technetium-99										

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 either criterion?
USGS-047	231W055	0.0394	0.504	231W084	0.604	0.533	-176	0.565	1.10	Yes
Uranium-234										
USGS-047	231W057	1.39	0.36	231W086	0.91	0.73	42	0.66	1.22	Yes
Uranium-235										
USGS-047	231W057	0.0504	0.0714	231W086	0.0783	0.268	-43	0.0279	0.416	Yes
Uranium-238										
USGS-047	231W057	0.672	0.243	231W086	1.61	0.911	-82	0.94	1.41	Yes
Plutonium-238										
USGS-047	231W053	0.0201	0.0696	231W082	0.0823	0.117	-121	0.0622	0.204	Yes
Plutonium-239/240										
USGS-047	231W053	0.000	0.0804	231W082	0.165	0.165	-200	0.165	0.275	Yes

[1]RPD calculation results in division by zero. Absolute difference in the duplicate sample results meets the ≤3(pooled error) criterion.

Table 37. Duplicate sample results for metals (µg/L) in groundwater, second quarter, 2023.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
USGS-047	231W059	04/03/2023	-	-	7.0	-	-	-	-	-
USGS-047	231W088	04/03/2023	-	-	6.9	-	-	-	-	-
RPD (%)			**-**	**-**	**1.4**	**-**	**-**	**-**	**-**	**-**
USGS-011	231W258	05/01/2023	-	-	4.0	-	-	-	-	-
USGS-011	231W282	05/01/2023	-	-	4.0	-	-	-	-	-
RPD (%)					**0.0**					
M7S	231W317	05/02/2023	-	-	10	-	-	-	-	-
M7S	231W323	05/02/2023	-	-	10	-	-	-	-	-
RPD (%)					**0.0**					
Atomic City	231W348	05/15/2023	-	-	2.4	-	-	-	-	-
Atomic City	231W353	05/15/2023	-	-	2.4	-	-	-	-	-
RPD (%)			**-**	**-**	**0.0**	**-**	**-**	**-**	**-**	**-**
TAN-51	231W418	06/13/2023	1.9J	93	4.8	<10	<1	<1	-	-
TAN-51	231W424	06/13/2023	1.9J	93	4.8	<10	<1	<1	-	-
RPD (%)			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-**	**-**

RPD = relative percent difference. J = estimated value.

Table 38. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, second quarter, 2023.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
USGS-047	231W058, 060	04/03/23	-	-	-	-	-	14.5	21.3	144	2.0	-
USGS-047	231W087, 089	04/03/23	-	-	-	-	-	14.5	21.3	145	2.0	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**-0.7**	**0.0**	**-**
USGS-011	231W257, 259	05/01/23	-	-	-	-	-	9.39	23.4	139	0.76	-
USGS-011	231W281,283	05/01/23	-	-	-	-	-	9.30	23.2	138	0.76	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**1.0**	**0.9**	**0.7**	**0.0**	**-**
M7S	231W316, 318	05/02/23	-	-	-	-	-	14.7	25.7	141	0.82	-
M7S	231W322, 324	05/02/23	-	-	-	-	-	14.4	25.5	139	0.82	-
RPD (%)								**2.1**	**0.8**	**1.4**	**0.0**	**-**
Atomic City	231W347, 349	05/15/23	-	-	-	-	-	17.0	18.0	133	1.7	-
Atomic City	231W352, 354	05/15/23	-	-	-	-	-	17.0	18.0	134	1.7	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**-0.8**	**0.0**	**-**
TAN-51	231W417, 418, 419	06/13/23	52	15	7.4	3.1	-	34.6	31.8	132	1.2	-
TAN-51	231W423, 424, 425	06/13/23	52	15	7.4	3.0	-	34.5	31.7	130	1.2	-
RPD (%)			**0.0**	**0.0**	**0.0**	**3.3**	**-**	**0.3**	**0.3**	**1.5**	**0.0**	**-**

RPD = relative percent difference.

† As $CaCO_3$.

Table 39. Duplicate sample results (µg/L) for VOCs in water, second quarter, 2023.

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	Styrene	Chloro-form	MEK
M7S	231W319	5/02/23	0.47J	2.39	<0.5	<0.5	<0.5	<0.5	<0.5	4.17	<0.5	<0.5	<0.5	0.88	<10
M7S	231W325	5/02/23	0.45J	2.68	<0.5	<0.5	<0.5	<0.5	<0.5	4.75	<0.5	<0.5	<0.5	0.85	<10
RPD (%)			**4.4**	**-11.4**	**0**	**0**	**0**	**0**	**0**	**-13.0**	**0**	**0**	**0**	**3.5**	**0**
TAN-51	231W420	6/13/23	25.0	239[1]	0.590	4.05	1.16 J+	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10
TAN-51	231W426	6/13/23	26.3	261[1]	0.640	3.78	1.21 J+	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<10
RPD (%)			**-5.1**	**-8.8**	**-8.1**	**6.9**	**-4.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

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).

[1] The sample was diluted by 10:1 for this analyte.

Table 40. Spiked sample results (µg/L) for metals in water, second quarter, 2023.

Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W342	5/09/2023				6.87	7.4	108									

Table 41. Spiked sample results (mg/L) for common ions and nutrients in water, second quarter, 2023.

Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W341	5/09/2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 41. (Continued). Spiked sample results (mg/L) for common ions and nutrients in water, second quarter, 2023.

Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as $CaCO_3$			Total Nitrogen			Total Phosphorus		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W341,343	5/09/2023	69.0	70.9	103	31.2	32.1	103	117	114	97	2.25	2.3	102	-	-	-

Table 42. Spiked sample results (µg/L) for VOCs in water, second quarter, 2023.

Sample Number	Sample Date	Carbon Tetrachloride			Styrene			Tetrachloroethene			Trichloroethene			Vinyl Chloride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W090	04/05/23	9.44	10.8	114	20.1	18.4	92	13.3	13.6	102	13.2	14.7	111	7.00	7.65	109
231W344	05/09/23	14.1	13.2	94	10.6	7.55	71	5.86	6.47	110	15.2	17.4	114	8.00	7.74	97

Table 42 continued. Spiked sample results (µg/L) for VOCs in water, second quarter, 2023.

Sample Number	Sample Date	1,1-Dichloroethene			trans-1,2-Dichloroethene			cis-1,2-Dichloroethene			1,2-Dichloroethane			Methylene Chloride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W090	04/05/23	15.0	17.5	117	11.3	13.2	117	17.9	18.7	104	15.5	16.2	105	17.8	20.8	117
231W344	05/09/23	7.99	7.90	99	9.21	11.8	128	18.3	19.7	108	8.41	9.43	112	15.1	22.8	151

Table 43. ISU-EML electret ionization chamber (EIC) irradiation results (categorized as spiked samples), second quarter, 2023.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SKR540	40.1	1.4	35.2	1.3	87.8%	Yes
SMV091	40.1	1.4	39.8	1.4	99.2%	Yes
SMV133	40.1	1.4	39.3	1.3	98.0%	Yes
				Triplicate AVG:	**95.0%**	**Yes**
SMV074	30.1	1.1	28.4	1.4	94.4%	Yes
SMD594	30.1	1.1	31.5	1.3	104.7%	Yes
SKR533	30.1	1.1	24.2	1.3	80.4%	Yes
				Triplicate AVG:	**93.2%**	**Yes**
SMV029	24.8	0.9	22.2	1.4	89.5%	Yes
SKR514	24.8	0.9	24.4	1.3	98.4%	Yes
SMV024	24.8	0.9	24.8	1.4	100.0%	Yes
				Triplicate AVG:	**96.0%**	**Yes**

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

Table 44. Air sampling field equipment service reliability (percent operational), second quarter, 2023.

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	100%	100%	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, second quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	03/30/23	04/06/23	0.1	0.3	12.4	1.1
	04/06/23	04/13/23	0.4	0.4	23.4	1.4
	04/13/23	04/20/23	0.5	0.4	15.5	1.2
	04/20/23	04/27/23	0.1	0.4	13.7	1.2
	04/27/23	05/04/23	1.5	0.5	27.5	1.5
	05/04/23	05/11/23	0.5	0.4	14.9	1.2
	05/11/23	05/18/23	0.7	0.4	20.8	1.3
	05/18/23	05/25/23	1.4	0.5	26.1	1.4
	05/25/23	06/01/23	0.6	0.4	17.4	1.2
	06/01/23	06/08/23	0.6	0.4	22.7	1.3
	06/08/23	06/14/23	0.5	0.4	23.8	1.4
	06/14/23	06/22/23	1.0	0.4	18.4	1.1
	06/22/23	06/29/23	0.7	0.4	21.6	1.3
Experimental Field Station	03/30/23	04/06/23	0.5	0.4	12.0	1.1
	04/06/23	04/13/23	0.8	0.4	22.4	1.3
	04/13/23	04/20/23	0.6	0.4	18.5	1.2
	04/20/23	04/27/23	0.5	0.4	15.2	1.2
	04/27/23	05/04/23	1.5	0.4	28.2	1.5
	05/04/23	05/11/23	0.6	0.4	15.3	1.2
	05/11/23	05/18/23	1.9	0.5	22.4	1.3
	05/18/23	05/25/23	1.7	0.5	26.2	1.3
	05/25/23	06/01/23	0.7	0.4	19.4	1.2
	06/01/23	06/08/23	0.5	0.3	20.5	1.2
	06/08/23	06/14/23	0.4	0.4	22.9	1.4
	06/14/23	06/22/23	0.9	0.3	18.1	1.1
	06/22/23	06/29/23	0.8	0.4	23.4	1.3
Sand Dunes Tower	03/30/23	04/06/23	0.3	0.3	11.0	1.0
	04/06/23	04/13/23	0.4	0.4	24.2	1.3
	04/13/23	04/20/23	0.5	0.3	17.9	1.2
	04/20/23	04/27/23	0.3	0.4	14.7	1.1
	04/27/23	05/04/23	1.2	0.4	27.1	1.4
	05/04/23	05/11/23	0.2	0.4	15.0	1.1
	05/11/23	05/18/23	0.7	0.4	19.3	1.2
	05/18/23	05/25/23	1.3	0.4	25.5	1.3
	05/25/23	06/01/23	0.6	0.4	19.1	1.2
	06/01/23	06/08/23	0.2	0.3	20.7	1.2
	06/08/23	06/14/23	0.2	0.3	23.8	1.4
	06/14/23	06/22/23	0.9	0.3	18.1	1.1
	06/22/23	06/29/23	0.6	0.3	21.3	1.3

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, second quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	03/30/23	04/06/23	0.0	0.3	11.2	1.0
	04/06/23	04/13/23	0.5	0.4	24.3	1.4
	04/13/23	04/20/23	0.4	0.4	15.7	1.2
	04/20/23	04/27/23	0.3	0.4	15.2	1.2
	04/27/23	05/04/23	0.9	0.4	26.4	1.4
	05/04/23	05/11/23	0.4	0.4	14.2	1.2
	05/11/23	05/18/23	0.6	0.4	19.2	1.3
	05/18/23	05/25/23	1.2	0.4	25.1	1.3
	05/25/23	06/01/23	0.4	0.4	19.5	1.2
	06/01/23	06/08/23	0.7	0.4	21.6	1.2
	06/08/23	06/14/23	0.6	0.4	24.1	1.4
	06/14/23	06/22/23	1.0	0.4	17.2	1.1
	06/22/23	06/29/23	0.9	0.4	24.3	1.3
Boundary Locations						
Atomic City	03/30/23	04/06/23	0.1	0.3	12.5	1.1
	04/06/23	04/13/23	0.2	0.4	23.0	1.4
	04/13/23	04/20/23	0.8	0.4	18.5	1.3
	04/20/23	04/27/23	0.7	0.4	14.2	1.2
	04/27/23	05/04/23	1.3	0.4	25.7	1.4
	05/04/23	05/11/23	0.8	0.5	15.0	1.2
	05/11/23	05/18/23	0.9	0.4	22.1	1.3
	05/18/23	05/25/23	1.4	0.5	24.4	1.3
	05/25/23	06/01/23	0.9	0.4	21.4	1.2
	06/01/23	06/08/23	0.5	0.4	22.5	1.2
	06/08/23	06/14/23	0.6	0.4	25.7	1.4
	06/14/23	06/22/23	1.0	0.3	18.0	1.1
	06/22/23	06/29/23	0.7	0.3	24.0	1.3
Howe	03/30/23	04/06/23	0.0	0.4	14.8	1.3
	04/06/23	04/13/23	0.4	0.4	27.7	1.6
	04/13/23	04/20/23	0.6	0.4	21.7	1.4
	04/20/23	04/27/23	0.3	0.4	16.2	1.3
	04/27/23	05/04/23	1.0	0.4	30.5	1.6
	05/04/23	05/11/23	0.3	0.4	16.5	1.3
	05/11/23	05/18/23	0.7	0.4	24.7	1.5
	05/18/23	05/25/23	1.6	0.5	27.4	1.5
	05/25/23	06/01/23	1.1	0.5	19.1	1.3
	06/01/23	06/08/23	0.7	0.4	20.7	1.3
	06/08/23	06/14/23	1.1	0.5	23.0	1.4
	06/14/23	06/22/23	1.2	0.4	18.1	1.1
	06/22/23	06/29/23	1.0	0.4	25.0	1.4

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, second quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	03/30/23	04/06/23	0.5	0.4	14.4	1.1
	04/06/23	04/13/23	0.3	0.4	22.6	1.3
	04/13/23	04/20/23	0.9	0.4	17.8	1.2
	04/20/23	04/27/23	0.6	0.4	14.9	1.1
	04/27/23	05/04/23	1.7	0.5	27.0	1.4
	05/04/23	05/11/23	1.0	0.5	14.6	1.2
	05/11/23	05/18/23	0.6	0.4	19.2	1.2
	05/18/23	05/25/23	1.3	0.4	23.5	1.3
	05/25/23	06/01/23	0.5	0.4	18.8	1.2
	06/01/23	06/08/23	0.5	0.3	18.5	1.1
	06/08/23	06/14/23	0.5 J[1]	0.4 J[1]	23.2 J[1]	1.4 J[1]
	06/14/23	06/22/23	0.6 J[1]	0.3 J[1]	18.0 J[1]	1.1 J[1]
	06/22/23	06/29/23	0.9	0.4	21.3	1.3
Mud Lake	03/30/23	04/06/23	0.2	0.3	13.5	1.1
	04/06/23	04/13/23	0.5	0.4	23.9	1.3
	04/13/23	04/20/23	0.5	0.4	19.9	1.2
	04/20/23	04/27/23	0.7	0.4	14.9	1.1
	04/27/23	05/04/23	1.6	0.5	26.9	1.4
	05/04/23	05/11/23	0.8	0.4	13.7	1.1
	05/11/23	05/18/23	0.9	0.4	19.3	1.2
	05/18/23	05/25/23	1.4	0.4	23.1	1.3
	05/25/23	06/01/23	0.6	0.4	19.7	1.2
	06/01/23	06/08/23	0.3	0.3	18.1	1.1
	06/08/23	06/14/23	0.9	0.4	23.4	1.4
	06/14/23	06/22/23	0.7	0.3	17.5	1.0
	06/22/23	06/29/23	0.9	0.4	19.3	1.2
Distant Locations						
Craters of the Moon	03/30/23	04/06/23	0.1	0.4	13.5	1.2
	04/06/23	04/13/23	0.2	0.4	22.7	1.4
	04/13/23	04/20/23	0.4	0.4	19.4	1.3
	04/20/23	04/27/23	0.2	0.4	15.4	1.2
	04/27/23	05/04/23	1.1	0.4	29.8	1.6
	05/04/23	05/11/23	0.1	0.4	15.0	1.2
	05/11/23	05/18/23	0.6	0.4	25.0	1.5
	05/18/23	05/25/23	1.5	0.5	28.1	1.4
	05/25/23	06/01/23	0.4	0.4	20.6	1.3
	06/01/23	06/08/23	0.6	0.4	23.2	1.3
	06/08/23	06/14/23	0.5	0.4	25.5	1.5
	06/14/23	06/22/23	0.7	0.3	19.1	1.2
	06/22/23	06/29/23	0.9	0.4	26.3	1.4

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, second quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[2]	03/30/23	04/06/23	0.1	0.3	9.6	0.9
	04/06/23	04/13/23	0.7	0.4	21.2	1.2
	04/13/23	04/20/23	0.7	0.4	18.1	1.2
	04/20/23	04/27/23	0.7	0.4	13.7	1.0
	04/27/23	05/04/23	1.4	0.4	24.6	1.3
	05/04/23	05/11/23	0.4	0.4	12.8	1.0
	05/11/23	05/18/23	0.8	0.4	20.8	1.2
	05/18/23	05/25/23	1.3	0.4	23.9	1.3
	05/25/23	06/01/23	0.7	0.4	20.8	1.2
	06/01/23	06/08/23	0.8	0.4	23.9	1.3
	06/08/23	06/14/23	0.7	0.4	25.5	1.5
	06/14/23	06/22/23	0.8	0.3	16.9	1.1
	06/22/23	06/29/23	0.9	0.4	22.8	1.3
Idaho Falls	03/30/23	04/06/23	0.1	0.3	14.5	1.1
	04/06/23	04/13/23	0.6	0.4	23.7	1.4
	04/13/23	04/20/23	0.4	0.3	17.6	1.2
	04/20/23	04/27/23	0.6	0.4	14.9	1.2
	04/27/23	05/04/23	1.1	0.4	26.2	1.4
	05/04/23	05/11/23	0.6	0.4	13.1	1.1
	05/11/23	05/18/23	0.8	0.4	21.0	1.3
	05/18/23	05/25/23	1.5	0.5	25.1	1.3
	05/25/23	06/01/23	0.4	0.3	21.9	1.3
	06/01/23	06/08/23	0.5	0.4	20.9	1.2
	06/08/23	06/14/23	0.5	0.4	24.7	1.4
	06/14/23	06/22/23	1.0	0.3	17.8	1.1
	06/22/23	06/29/23	0.9	0.4	20.9	1.2

Note: MDCs typically range from (0.4 to 0.7) x 10^{-3} pCi/m^3 for gross alpha and from (0.8 to 1.2) x 10^{-3} pCi/m^3 for gross beta.

[1] J – Values are estimates. Air volumes were estimated.
[2] Operated by Shoshone-Bannock Tribes.

Appendix B

Table B-1. Results for all electret ionization chamber (EIC) locations, second quarter, 2023.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	10.6	1.7
Craters of the Moon	11.0	3.0
Big Lost River Rest Area	R[2]	R
Van Buren Avenue	11.0, 13.2	-
Experimental Field Station	14.4	4.3
Main Gate	12.9	4.6
Atomic City	14.8, 15.9	-
Taber	12.4	2.9
Blackfoot	11.4	3.8
Ft. Hall	9.5	3.2
Idaho Falls	11.4	1.7
Mud Lake/ Terreton	9.8, 12.4	-
Monteview	11.2	1.5
Sand Dunes	13.9	2.5
Howe Met. Tower	11.7	2.5
MP282 -20	13.9	4.7
MP280 -20	12.4	1.9
MP278 -20	11.4	1.6
MP276 -20	12.6	3.8
MP274 -20	11.7	2.8
MP272 -20	13.2	2.7
MP270 -20	14.3	2.4
MP268 -20	15.2	2.6
MP266 -20	11.5	1.0
MP264 -20	12.9	1.2
MP270 -20/26	15.5	2.2
MP268 -20/26	15.1	1.8
MP266 -20/26	13.0	4.2
MP263 -20/26	14.8	1.4
MP261 -20/26	12.5	3.2
MP259 -20/26	12.1	1.6
MP256 -20/26	10.5	2.9
MFC (EBR II)	15.1	1.5
EBR I	11.2	3.7
RWMC	12.6	2.1
CFA	11.9	3.8
CITRC (PBF)	14.9	4.1
INTEC	18.4	4.3
ATR (TRA)	13.1	5.2
NRF	13.8	4.3
TAN/SMC	9.9	2.7
Mud Lake Bank of Commerce	15.8	2.1
MP43-33	13.6	1.5
MP41-33	14.9	2.9
MP39-33	13.8, 15.5	-
MP37-33	12.6	3.1
MP35-33	12.0	3.9
MP33-33	13.2, 15.8	-
MP31-33	13.2	3.6
MP29-33	14.1	4.0
MP27-33	12.9	3.7

Table B-1. continued. Results for all electret ionization chamber (EIC) locations, second quarter, 2023.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP25-33	10.4	2.8
MP23-33	NS[3]	NS
MP21-33	11.3	2.2
MP19-33	14.0, 16.0	-
MP14-33	11.1	2.8
MP11-33	10.5	3.4
MP06-33	10.2	2.7
MP03-33	13.4	1.0
Base of Howe	11.2, 13.2	-
Rover	13.4	3.2
Hamer	14.7	0.2
Sugar City	15.9	2.9
Roberts	12.0	2.0
Big Southern Butte	20.0	3.7
T4 North	14.7	3.9
T4 South	13.4	3.0

[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] Wide variability among all three EICs was unacceptable. Data from this location was qualified as rejected (R).
[3] NS – No sample. Milepost marker missing. EICs were not deployed at this location.

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