Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

July - September, 2023

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Table of Contents

List of Tables

List of Figures

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 third 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 third 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 Sand Dunes Tower 8x10-inch filter September composite, the Cs-137 concentration was equal to the MDC and equal to 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 1×10^{-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 levels require further investigation.

Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during second quarter 2023 are presented in **Table 5.** There were Sr-90 detections at all four on-site locations for the second quarter of 2023, suggesting a possible INL source. However, there was also a Sr-90 detection at one distant location (Fort Hall). These results were all greater-than-MDC and greater-than-three sample standard deviations. There were no greater-than-MDC results for Pu-238, Pu-239/240, or Am-241 for the second quarter of 2023.

Radioactive iodine samples are collected weekly. Samples are collected by drawing air through a canister filled with activated charcoal using a low-volume air pump. The activated charcoal contained in the canister traps the radioiodine by adsorption onto its porous surface. Each week, canisters are collected from all eleven air monitoring stations and analyzed together as a composite using gamma spectrometry (**Table 6**). If Iodine-131 is detected in this grouping, the canisters are individually analyzed. No radioactive isotopes of iodine, specifically Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the third quarter of 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 individual sample tritium concentration was equal to its MDC and exceeded 3 SD at the Experimental Field Station. 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 third 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 and man-made gamma emitting radionuclides were below minimum detectable concentrations in precipitation collected during the third 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**.

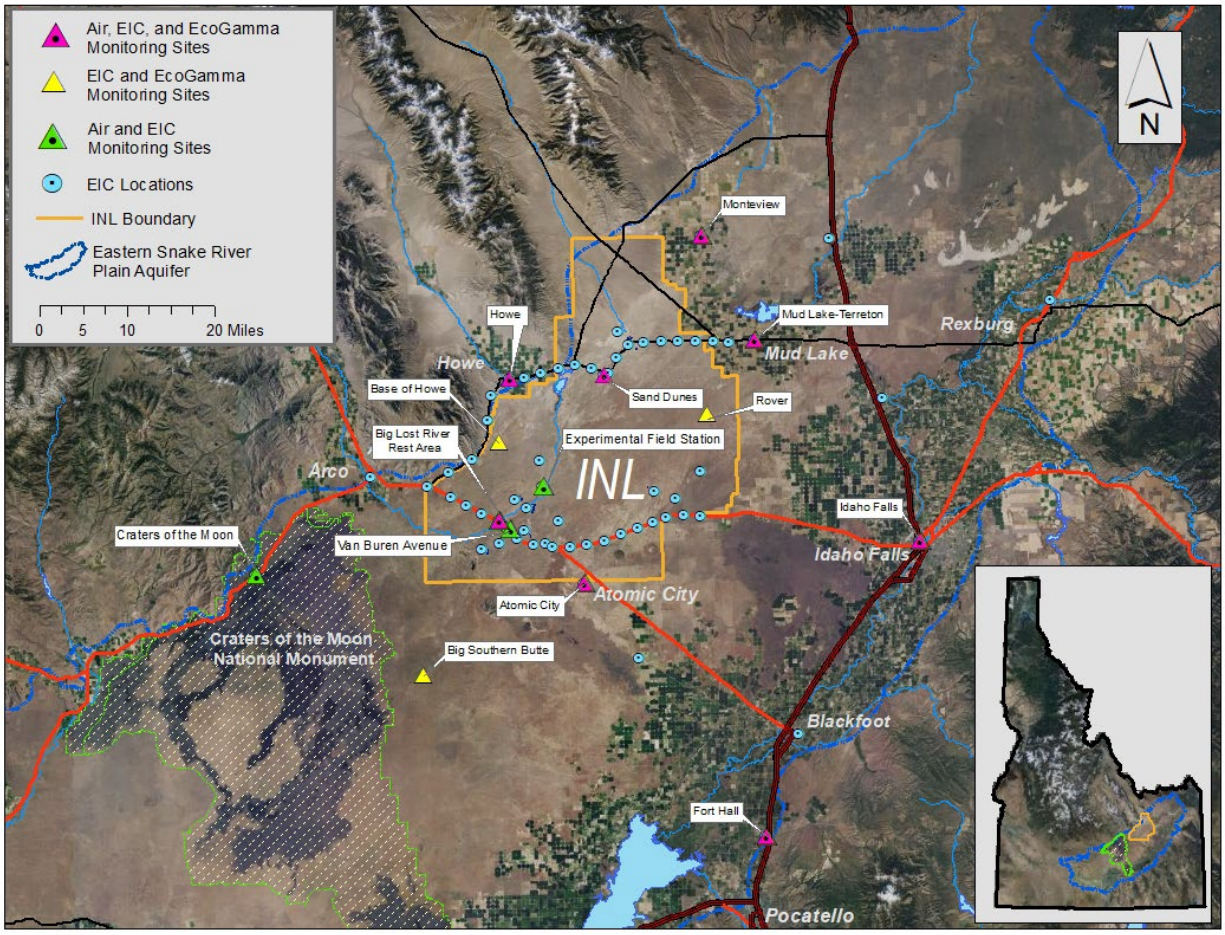

Figure 1. Air and radiation monitoring locations.

Table 1. Sampling locations and sample type

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

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

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, third quarter, 2023.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.6	-	1.3	19.4	-	34.6
Experimental Field Station	0.5	-	1.6	19.9	-	35.6
Sand Dunes Tower	0.5	-	1.3	18.4	-	35.2
Van Buren Avenue	0.7	-	1.5	18.2	-	35.8
Boundary Locations						
Atomic City	0.8	-	3.0	18.3	-	36.3
Howe	0.6	-	1.2	19.1	-	35.0
Monteview	0.5	-	1.3	17.6	-	32.8
Mud Lake	0.5	-	1.2	18.3	-	33.9
Distant Locations						
Craters of the Moon	0.6	-	1.3	19.3	-	35.7
Fort Hall[1]	0.6	-	1.4	16.2	-	33.3
Idaho Falls	0.6	-	1.3	16.7	-	32.7

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

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

Station Location	Naturally Occurring Radionuclide Beryllium-7			Man-Made Gamma Emitting Radionuclides		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC[2]
On-site Locations						
Big Lost River Rest Area	115.3	7.3	1.5	-0.02	0.04	0.08
Experimental Field Station	104.0	6.7	1.5	0.01	0.05	0.09
Sand Dunes Tower	120.7	7.2	2.3	0.03	0.07	0.12
Van Buren Avenue	111.5	6.7	1.7	0.10	0.10	0.17
Boundary Locations						
Atomic City	107.2	6.8	1.3	0.03	0.07	0.12
Howe	119.9	7.3	2.1	0.04	0.08	0.13
Monteview	105.5	6.6	2.3	0.10	0.09	0.15
Mud Lake	104.1	6.3	2.2	0.03	0.07	0.12
Distant Locations						
Craters of the Moon	112.2	7.0	2.4	0.04	0.08	0.13
Fort Hall[1]	96.7	6.1	2.1	0.03	0.08	0.14
Idaho Falls	97.6	6.2	1.5	-0.01	0.06	0.10

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, third 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	July	169.2	11.3	0.9	0.03	0.05	0.07
	Aug	116.1	6.7	1.1	0.01	0.03	0.04
	Sept	67.8	7.6	0.7	-0.01	0.02	0.04
Experimental Field Station	July	157.3	9.0	1.1	0.05	0.03	0.06
	Aug	119.6	7.3	0.7	0.01	0.02	0.03
	Sept	60.1	8.8	0.8	0.01	0.02	0.04
Sand Dunes Tower	July	172.3	9.7	0.8	0.03	0.03	0.05
	Aug	111.9	7.5	0.6	0.00	0.02	0.04
	Sept	70.0	8.7	0.9	0.06 J[5]	0.04	0.06
Van Buren Avenue	July	170.0	9.7	1.1	0.02	0.03	0.06
	Aug	112.8	7.6	0.6	0.01	0.02	0.04
	Sept	69.2	8.5	0.6	0.04	0.04	0.06
Boundary Locations							
Atomic City	July	166.2	9.4	0.7	0.04	0.05	0.08
	Aug	114.6	7.0	0.5	0.01	0.02	0.03
	Sept	71.7	8.1	0.7	-0.01	0.02	0.03
Howe	July	179.1	10.9	0.7	0.02	0.02	0.03
	Aug	140.2	9.4	0.5	0.00	0.03	0.04
	Sept	81.9	10.1	0.7	0.02	0.03	0.05
Monteview	July	154.2	9.4	0.7	-0.01	0.02	0.03
	Aug	111.5	6.8	0.5	0.00	0.02	0.04
	Sept	65.5	8.1	0.7	0.02	0.03	0.05
Mud Lake	July	174.8	10.6	0.7	-0.02	0.03	0.05
	Aug	138.5	9.3	0.6	0.01	0.03	0.04
	Sept	70.0	10.6	0.6	0.01	0.03	0.05
Distant Locations							
Craters of the Moon	July	156.0	9.5	0.7	0.01	0.02	0.03
	Aug	104.7	6.0	0.9	0.01	0.02	0.04
	Sept	66.4	7.0	1.0	0.05	0.05	0.08
Fort Hall[1]	July	169.2	9.7	1.1	0.04	0.04	0.06
	Aug	122.4	7.0	0.9	0.04	0.03	0.05
	Sept	56.1	6.0	0.9	0.03	0.04	0.06
Idaho Falls	July	193.9	12.9	0.8	0.02	0.03	0.05
	Aug	142.6	9.5	0.7	0.02	0.03	0.05
	Sept	85.3	9.0	1.2	0.03	0.03	0.05
Idaho Falls Duplicate[3]	July	158.7	9.7	0.7	-0.01	0.02	0.03
	Aug	115.9	7.1	0.6	0.00	0.02	0.03
	Sept	72.6	8.2	0.7	0.01	0.02	0.04

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] Concentration, SD, and MDC are for Cs-137.
[3]A duplicate 8x10-inch filter TSP sampler is currently being operated at the Idaho Falls location.
[4] Four filters/composite for July and September; five filters/composite for August.
[5] The Cs-137 concentration is equal to the MDC and equal to 3 SD. The 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 second quarter 2023.

Station Location	^{90}Sr			^{238}Pu			$^{239/240}$Pu			^{241}Am		
	Value[1]	±2SD	MDC	Value[1]	± 2SD	MDC	Value[1]	±2SD	MDC	Value[1]	±2SD	MDC
On-Site Locations												
BLR[4] Rest Area	0.65 J[6]	0.33	0.46	0.03 J[6]	0.10	0.19	-0.01 J[6]	0.02	0.09	-0.01 J[6]	0.09	0.19
EFS[3]	0.50	0.31	0.46	0.02	0.09	0.17	-0.01	0.03	0.10	0.09	0.11	0.18
Sand Dunes Tower	0.63	0.28	0.39	0.02	0.07	0.14	0.02	0.05	0.10	0.00	0.09	0.18
Van Buren Avenue	0.45	0.28	0.42	0.01	0.08	0.16	0.03	0.05	0.07	0.05	0.09	0.16
Boundary Locations												
Atomic City	0.24 J[6]	0.27	0.45	0.04 J[6]	0.09	0.17	0.03 J[6]	0.05	0.08	-0.04 J[6]	0.10	0.21
Howe	0.40	0.28	0.43	0.04	0.08	0.14	0.01	0.03	0.04	0.04	0.09	0.16
Monteview	0.38	0.30	0.48	0.00	0.07	0.15	0.02	0.04	0.09	0.03	0.09	0.17
Mud Lake	-0.01	0.25	0.46	0.09	0.10	0.16	0.00	0.03	0.08	0.03	0.09	0.17
Distant Locations												
Craters of the Moon	0.20	0.29	0.48	0.03	0.08	0.16	0.02	0.05	0.10	-0.03	0.12	0.25
Fort Hall[2]	0.76	0.33	0.46	0.02	0.09	0.17	0.05	0.06	0.08	0.04	0.09	0.16
Idaho Falls	0.25	0.28	0.46	0.00	0.06	0.14	0.03	0.04	0.06	-0.05	0.08	0.18
Idaho Falls Duplicate[5]	-0.05	0.23	0.43	0.00	0.07	0.16	-0.02	0.02	0.09	0.05	0.12	0.22

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

[1] Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons, and possibly from INL programs. DEQ-INL OP's action levels of 19 for americium-241, 190 for strontium-90, 21 for plutonium-238, and 20 for plutonium-239/240 (in 1 x 10^{-5} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.

[2] Operated by Shoshone-Bannock Tribes.

[3] EFS - Experimental Field Station.

[4] BLR – Big Lost River.

[5] Dup – Duplicate TSP sampler being run at the Idaho Falls location.

[6] Sampler pump/airflow issues were noted at these locations for the month of June. Results are J-flagged as estimates.

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

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA[1]
06/29/23	07/06/23	-0.49	1.62	2.78
07/06/23	07/13/23	-1.18	1.61	2.81
07/13/23	07/20/23	0.34	3.05	5.12
07/20/23	07/27/23	0.21	1.63	2.76
07/27/23	08/03/23	1.47	2.01	3.32
08/03/23	08/10/23	-0.16	1.92	3.27
08/10/23	08/17/23	-0.75	2.49	4.22
08/17/23	08/24/23	0.05	1.58	2.68
08/24/23	08/31/23	-0.65	2.43	4.12
08/31/23	09/07/23	1.00	1.63	2.71
09/07/23	09/14/23	-0.41	1.90	3.24
09/14/23	09/21/23	0.84	2.07	3.46
09/21/23	09/28/23	0.63	2.48	4.15

[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 5.12 pCi/composite is equivalent to a maximum MDC of 8.2 x10^{-4} pCi/m^3.

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

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	06-29-2023	07-14-2023	0.36	0.36	0.60
Big Lost River Rest Area	07-14-2023	08-03-2023	-0.12	0.42	0.79
Big Lost River Rest Area	08-03-2023	08-17-2023	0.20	0.41	0.75
Big Lost River Rest Area	08-17-2023	09-07-2023	0.26	0.39	0.71
Big Lost River Rest Area	09-07-2023	09-28-2023	0.16	0.32	0.53
Big Lost River Rest Area Mean	**06-29-2023**	**09-28-2023**	**0.18**	**0.37**	**0.66**
Experimental Field Station	06-29-2023	07-14-2023	0.31	0.31	0.46
Experimental Field Station	07-14-2023	07-27-2023	0.40	0.34	0.57
Experimental Field Station	07-27-2023	08-10-2024	0.21	0.42	0.70
Experimental Field Station	08-10-2024	08-24-2023	0.68	0.41	0.68
Experimental Field Station	08-24-2023	09-14-2023	0.07	0.41	0.68
Experimental Field Station	09-14-2023	09-28-2023	0.35	0.30	0.50
Experimental Field Station Mean	**06-29-2023**	**09-28-2023**	**0.33**	**0.36**	**0.59**
Sand Dunes Tower	06-29-2023	07-14-2023	0.06	0.37	0.61
Sand Dunes Tower	07-14-2023	07-27-2023	0.12	0.35	0.58
Sand Dunes Tower	07-27-2023	08-10-2023	0.07	0.48	0.76
Sand Dunes Tower	08-10-2023	08-31-2023	0.38	0.45	0.83
Sand Dunes Tower	08-31-2023	09-21-2023	0.44	0.38	0.63
Sand Dunes Tower	09-21-2023	09-28-2023	0.06	0.44	0.68
Sand Dunes Tower Mean	**06-29-2023**	**09-28-2023**	**0.20**	**0.40**	**0.68**
Van Buren Avenue	06-29-2023	07-14-2023	0.41	0.35	0.53
Van Buren Avenue	07-14-2023	08-03-2023	0.23	0.34	0.57
Van Buren Avenue	08-03-2023	08-17-2023	0.52	0.39	0.65
Van Buren Avenue	08-17-2023	09-07-2023	0.28	0.48	0.83
Van Buren Avenue	09-07-2023	09-28-2023	0.05	0.30	0.46
Van Buren Avenue Mean	**06-29-2023**	**09-28-2023**	**0.28**	**0.38**	**0.61**
Boundary Locations					
Atomic City	06-29-2023	07-14-2023	0.50	0.37	0.56
Atomic City	07-14-2023	08-03-2023	0.06	0.35	0.58
Atomic City	08-03-2023	08-17-2023	0.42	0.49	0.84
Atomic City[1]	08-17-2023	09-07-2023	0.19	0.38	0.70
Atomic City	09-07-2023	09-28-2023	0.16	0.32	0.53
Atomic City Mean (J)	**06-29-2023**	**09-28-2023**	**0.23**	**0.38**	**0.64**
Howe	06-29-2023	07-14-2023	0.34	0.41	0.61
Howe	07-14-2023	08-03-2023	-0.13	0.40	0.67
Howe	08-03-2023	08-17-2023	0.66	0.44	0.73
Howe	08-17-2023	08-31-2023	0.21	0.43	0.71
Howe	08-31-2023	09-14-2023	0.58	0.44	0.73
Howe	09-14-2023	09-28-2023	0.05	0.33	0.54
Howe Mean	**06-29-2023**	**09-28-2023**	**0.27**	**0.41**	**0.67**
Mud Lake	06-29-2023	07-20-2023	0.70	0.53	0.79
Mud Lake	07-20-2023	08-03-2023	-0.18	0.54	0.90
Mud Lake	08-03-2023	08-17-2023	0.63	0.54	0.81
Mud Lake	08-17-2023	08-31-2023	0.32	0.64	1.17
Mud Lake	08-31-2023	09-14-2023	-0.08	0.50	0.75
Mud Lake	09-14-2023	09-28-2023	0.37	0.37	0.61
Mud Lake Mean	**06-29-2023**	**09-28-2023**	**0.29**	**0.52**	**0.84**
Monteview	06-29-2023	07-14-2023	0.07	0.45	0.74

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
Monteview	07-14-2023	07-27-2023	0.08	0.59	0.93
Monteview	07-27-2023	08-10-2023	0.50	0.50	0.84
Monteview	08-10-2023	08-24-2023	0.54	0.54	0.90
Monteview	08-24-2023	09-07-2023	0.44	0.53	0.88
Monteview	09-07-2023	09-28-2023	0.19	0.44	0.69
Monteview Mean	**06-29-2023**	**09-28-2023**	**0.28**	**0.50**	**0.82**
Distant Locations					
Craters of the Moon	06-29-2023	07-14-2023	0.21	0.32	0.48
Craters of the Moon	07-14-2023	08-03-2023	0.21	0.37	0.58
Craters of the Moon	08-03-2023	08-17-2023	0.59	0.46	0.72
Craters of the Moon	08-17-2023	09-07-2023	0.22	0.44	0.74
Craters of the Moon	09-07-2023	09-28-2023	0.05	0.29	0.48
Craters of the Moon Mean	**06-29-2023**	**09-28-2023**	**0.23**	**0.37**	**0.59**
Fort Hall[2]	06-29-2023	07-20-2023	0.12	0.24	0.41
Fort Hall	07-20-2023	08-03-2023	0.08	0.48	0.80
Fort Hall	08-03-2023	08-17-2023	0.32	0.48	0.88
Fort Hall	08-17-2023	08-31-2023	0.09	0.66	1.13
Fort Hall	08-31-2023	09-07-2023	0.55	0.56	1.02
Fort Hall	09-07-2023	09-21-2023	0.06	0.39	0.65
Fort Hall	09-21-2023	09-28-2023	0.06	0.38	0.64
Fort Hall Mean	**06-29-2023**	**09-28-2023**	**0.16**	**0.43**	**0.74**
Idaho Falls	06-29-2023	07-14-2023	0.29	0.44	0.66
Idaho Falls	07-14-2023	07-27-2023	0.08	0.45	0.76
Idaho Falls	07-27-2023	08-10-2023	0.32	0.56	0.88
Idaho Falls	08-10-2023	08-24-2023	0.43	0.51	0.85
Idaho Falls	08-24-2023	09-07-2023	0.49	0.49	0.82
Idaho Falls	09-07-2023	09-21-2023	0.19	0.37	0.68
Idaho Falls	09-21-2023	09-28-2023	0.04	0.12	0.21
Idaho Falls Mean	**06-29-2023**	**09-28-2023**	**0.28**	**0.45**	**0.73**

Note: Concentrations are reported in pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1] Calculations assumed an uptake of 100 grams in adsorption media during sampling period (mean noted with a "J" for estimate).
[2] Station operated by the Shoshone-Bannock Tribes.

Table 8. Tritium and gamma-emitting radionuclide concentrations from precipitation, third 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	06/29/23	08/24/23	30	60	110	-0.7	1.1	2.1
Big Lost River Rest Area	08/24/23	09/28/23	20	70	110	1.7	1.9	3.1
Big Lost River Rest Area Mean	**06/29/23**	**09/28/23**	**26**	**64**	**110**	**0.3**	**1.5**	**2.5**
Boundary Locations								
Atomic City	06/29/23	08/31/23	10	60	100	1.3	1.7	2.9
Atomic City	08/31/23	09/28/23	40	70	110	0.7	1.2	2.0
Atomic City Mean	**06/29/23**	**09/28/23**	**21**	**64**	**104**	**1.1**	**1.6**	**2.6**
Howe	06/29/23	08/24/23	-20	60	110	0.4	1.5	2.5
Howe	08/24/23	09/28/23	-10	70	110	0.9	1.4	2.3
Howe Mean	**06/29/23**	**09/28/23**	**-16**	**64**	**110**	**0.6**	**1.5**	**2.4**
Mud Lake	06/29/23	08/24/23	20	60	100	0.6	1.5	2.5
Mud Lake	08/24/23	09/28/23	0	60	100	0.0	1.1	1.9
Mud Lake Mean	**06/29/23**	**09/28/23**	**14**	**60**	**100**	**0.4**	**1.4**	**2.3**
Monteview	06/29/23	08/24/23	70	60	100	1.1	1.4	2.3
Monteview	08/24/23	09/28/23	90	70	110	0.8	1.3	2.2
Monteview Mean	**06/29/23**	**09/28/23**	**76**	**63**	**103**	**1.0**	**1.4**	**2.2**
Distant Locations								
Idaho Falls	**06/29/23**	**09/28/23**	**-30**	**60**	**100**	**1.3**	**1.5**	**2.4**

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

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the third quarter of 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 third quarter of 2023. **Table 11** lists the EIC monitoring results for the third 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, third quarter 2023, from EcoGamma network.

Station Location	Exposure Rate (µR/hr)			
	Quarterly Average*	± 2 SD	Median	Range**
On-site Locations				
Base of Howe	13.7	1.3	13.7	11.4 – 20.8
Big Lost River Rest Area	14.3	1.3	14.3	12.1 – 20.0
Rover[3]	15.0	1.4	14.9	12.4 – 22.8
Sand Dunes Tower	14.0	1.2	14.0	11.8 – 20.0
Boundary Locations				
Atomic City	13.8	1.2	13.7	11.6 – 19.2
Big Southern Butte	14.3	1.2	14.3	12.2 – 18.6
Big Southern Butte duplicate[1]	14.2	1.2	14.2	12.4 – 18.4
Howe Met Tower	13.0	1.5	12.9	10.7 – 19.5
Monteview	13.4	1.2	13.3	11.1 – 18.2
Mud Lake / Terreton	13.1	1.3	13.0	10.7 – 20.3
Distant Locations				
Fort Hall	12.4	1.2	12.4	10.7 – 18.2
Idaho Falls[2]	14.0	1.2	14.0	11.9 – 19.1

*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 7 – 34 µR/hr.
[1] No data from the EcoGamma at this location 7/6 – 7/15/23, 7/16 – 7/28/23, and 7/30 – 8/3/23.
[2] No data from the EcoGamma at this location 7/17 – 7/23/23 and 8/6 – 8/22/23.
[3] The EcoGamma was in operation intermittently at the Rover location from 07/02/23 to 09/29/23, producing a comparatively small dataset.

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

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	14.2	2.9
Big Lost River Rest Area	14.1, 14.9	-
Experimental Field Station	15.5	4.9
Rover	17.5	3.3
Sand Dunes Tower	14.6	2.8
Van Buren Avenue	13.6	4.0
Boundary Locations		
Atomic City	11.2	0.9
Big Southern Butte	15.6	3.2
Howe Met Tower	13.8	1.7
Monteview	12.9	2.3
Mud Lake/Terreton	15.3	1.6
Distant Location		
Craters of the Moon	13.4	2.0
Fort Hall	13.1	1.5
Idaho Falls	9.4	2.1

[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 ±3 SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.

Water Monitoring Results

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

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

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

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

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

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

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

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

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

During the third quarter of 2023, DEQ-INL OP sampled groundwater from the aquifer at one facility location and 13 distant locations. **Table 12** lists the sample date, co-sampler, well depth, and analyses requested for the locations sampled this quarter. Analytical results are reported in **Tables 14 through 23** and summarized below. The results of low-level tritium analyses for 14 samples collected in the second quarter, along with eight samples collected in the third quarter of 2023, are reported in **Table 16** and discussed below.

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

Gross alpha and gross beta radioactivity

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

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

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

Gross alpha radioactivity was not detected in all samples this quarter (**Table 14)**. Facility well TAN-2336 had the highest gross beta concentration of 1345 ± 50 pCi/L, MDC = 39 pCi/L. TAN-2336 is undergoing active remediation for VOC contamination. The injection media alters groundwater redox conditions at the location, which likely remobilized beta-emitting radionuclides. Gross beta concentrations measured at distant wells were within the known background ranges.

Manmade gamma-emitting radionuclides

TAN-2336 had a detection of 7.8 ± 2.4 pCi/L, MDC = 3.6 pCi/L for cesium-137. No other manmade gamma-emitting radionuclides were detected at the locations sampled this quarter. TAN-2336 is undergoing active remediation for VOC contamination. Gamma-emitting radionuclides were likely remobilized due to the injection media that alters groundwater redox conditions at the location. This location will be closely monitored as remediation continues. Results for cesium-137 (^{137}Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 14**.

Tritium

Tritium was measured at all locations sampled this quarter (**Table 15**) using the standard analytical method, which typically has an MDC of 110 to 190 pCi/L. Tritium was detected at facility well TAN-2336 (298 ± 70 pCi/L, MDC = 100 pCi/L). This value is typical of wells located at the TAN facility. There were no tritium detections using the standard analysis method for any of the distant wells sampled this quarter.

Fourteen samples from the second quarter and eight samples from third quarter (2023) were analyzed by the low-level tritium method and the results are reported in **Table 16**. Two facility, one upgradient, eleven boundary, and eight distant locations were sampled. The highest concentrations detected were 657 ± 12 pCi/L, MDC = 7 pCi/L in USGS-131A (812 ft bgs), 612 ± 22 pCi/L, MDC = 13 pCi/L in USGS-131A (616 ft bgs) and 410 ± 12 pCi/L, MDC = 7 pCi/L in M7S. The results are consistent with the historical ranges of these wells. TAN-2312 displayed a tritium concentration of 113 ± 7 pCi/L, MDC = 7 pCi/L. This elevated tritium concentration is atypical for this well, which has been a non-detection since sampling began in 2019. To confirm the results, it was requested that the lab reanalyze the sample with the results to be provided in a subsequent quarterly report. All reported concentrations for the distant wells are within the background range (≤ 33 pCi/L) and all tritium concentrations reported in this quarter are well below the drinking water MCL of 20,000 pCi/L. A backlog of seven samples for low-level tritium analysis remains.

Strontium-90

One aquifer facility location (TAN-2336) was sampled for ^{90}Sr this quarter (**Table 17**). An elevated concentration of 508 ± 43 pCi/L, MDC = 2 pCi/L was measured, which is consistent with the historical range from this well.

Uranium Isotopes

One aquifer location at the TAN facility was sampled for uranium isotopes (^{234}U, ^{235}U, and ^{238}U) this quarter; TAN-2336 (**Table 18**). Concentrations for ^{234}U, ^{235}U, and ^{238}U were all less than MDC and within established background concentrations.

Common ions, trace metals, and nutrients

All locations were sampled for chloride, sulfate, alkalinity, chromium, and dissolved nutrients (nitrate-plus-nitrite) (**Tables 19, 20 and 21)**. TAN-2336 was the only location sampled for additional common ions, phosphorus, and an expanded metals suite during the quarter.

Active bioremediation is occurring at TAN-2336. Bioremediation activities alter geochemical conditions in the aquifer resulting in the mobilization of various chemical constituents. Most analytes at TAN-2336 are above background ranges including chromium (360 µg/L), barium (1800 µg/L), iron (8500 µg/L), magnesium (130 mg/L), and manganese (460 µg/L). Although the arsenic concentration is also above background levels at 24 µg/L, it is below MDC and therefore considered a non-detect. Additionally, TAN-2336 displayed elevated concentrations of alkalinity, sodium, potassium, and phosphorus during the sampling period.

All analytes tested at distant wells were within background ranges, with the exception of several sulfate and nitrate + nitrite results. Sulfate concentrations were above background concentrations for MV-11 (81.8 mg/L), MV-24A (76.1 mg/L), MV-43 (68.7 mg/L), MV-50 (67.3 mg/L), MV-18 (65.9 mg/L), MV-30 (64.7 mg/L), MV-23 (51.3 mg/L), and MV-01 (46.2 mg/L). Nitrate concentrations were above background concentrations for MV-43 (8.0 mg/L), MV-11 (6.0 mg/L), MV-24A (5.9 mg/L), and MV-23 (4.6 mg/L). All results are consistent with historical trends. Elevated nitrate + nitrite, sulfate, and chloride at distant locations are likely associated with agricultural practices in the Magic Valley.

Volatile organic compounds (VOCs)

Two VOCs, which represent side reactions to the on-going in-situ bioremediation process, were detected at TAN-2336 during this quarter (**Table 22**); 2-Hexanone (60.4 µg/L) and 2-Butanone (methyl ethyl ketone) (2310 µg/L). There are currently no federal standards for these analytes.

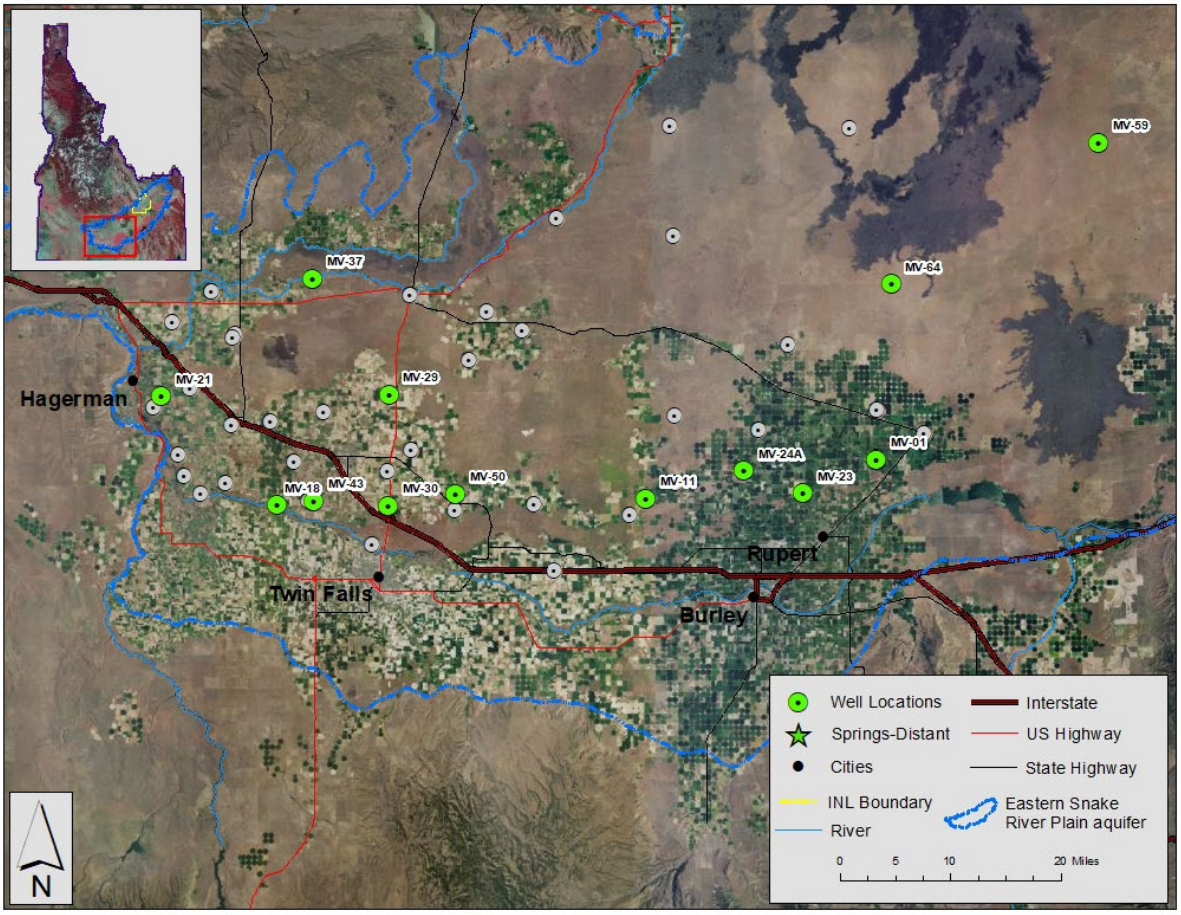

Figure 2. Distant and Surface Water monitoring locations.

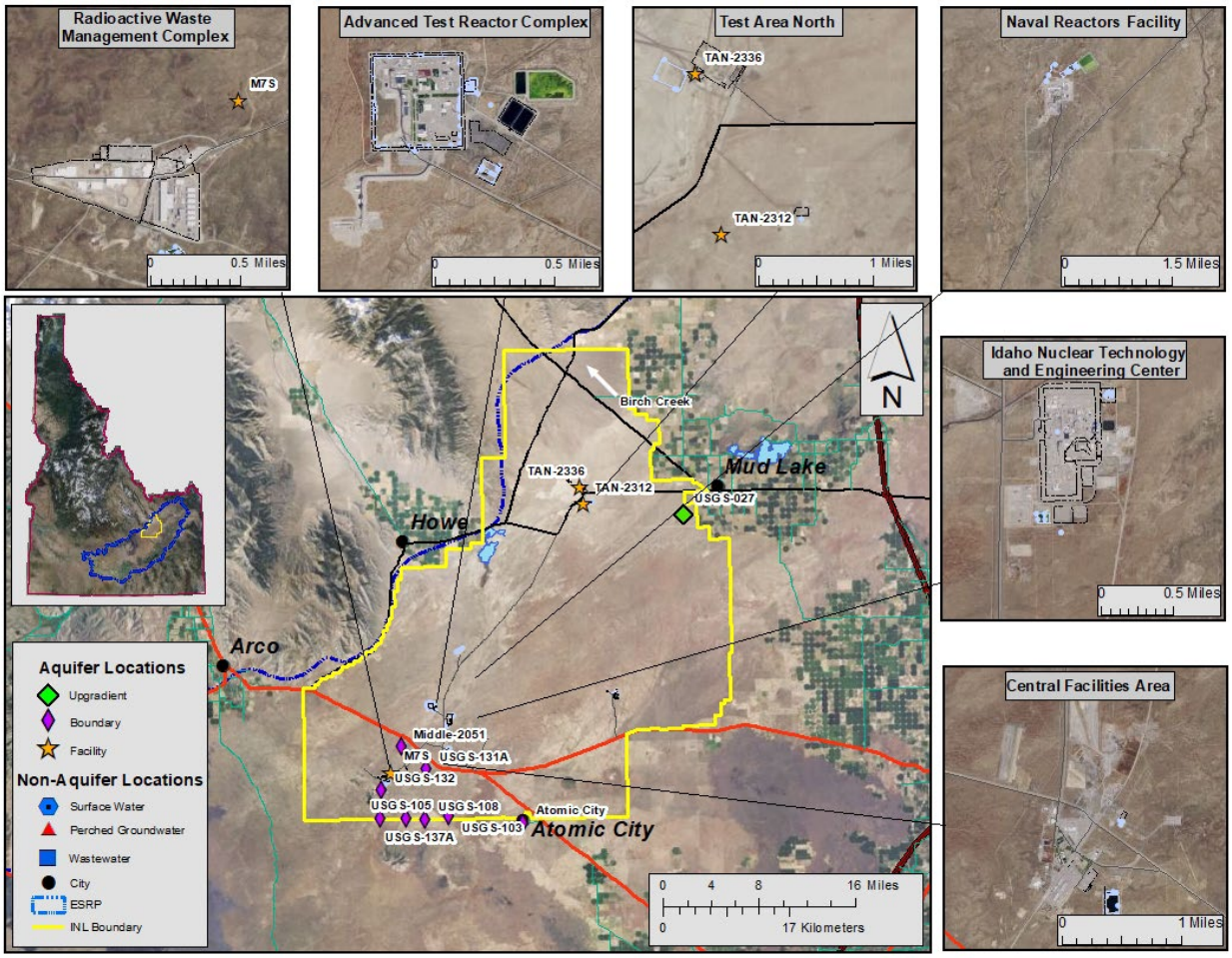

Figure 3. Up-gradient, facility, boundary, perched groundwater, and wastewater monitoring locations.

Table 12. Locations sampled for water, third quarter, 2023.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Facility				
Test Area North				
TAN-2336	7/12/2023	IEC	255	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, P, VOCs
Distant				
MV-01	7/19/2023	None	217.5	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-11	7/19/2023	None	341	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-18	7/20/2023	None	118	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-21	7/20/2023	None	128	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-23	7/19/2023	None	130	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-24A	7/19/2023	None	280	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-29	7/19/2023	None	371	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-30	7/19/2023	None	200	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-37	7/20/2023	None	180	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-43	7/20/2023	None	240.5	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-50	7/19/2023	None	369	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-59	7/27/2023	None	1,091	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2
MV-64	08/24/2023	IDWR	426	α, β, γ, ^{3}H, Cl-, SO_4^{2-}, alk, Cr, NO_3+NO_2

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

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

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

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

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Test Area North										
TAN-2336	7/11/2023	-18.1	U	26.1	1345	-	50	7.8	-	2.4
Distant										
MV-01	7/19/2023	0.9	U	1.2	7.5	-	1.1	-0.5	U	1.6
MV-11	7/19/2023	-0.1	U	1.0	8.0	-	1.1	1.5	U	1.4
MV-18	7/20/2023	0.0	U	1.0	6.4	-	1.0	0.9	U	1.4
MV-21	7/20/2023	1.3	U	1.0	3.8	-	0.8	-0.2	U	1.1
MV-23	7/19/2023	0.8	U	1.0	6.7	-	1.0	-0.4	U	1.1
MV-24A	7/19/2023	0.2	U	1.1	7.6	-	1.1	2.0	U	1.5
MV-29	7/19/2023	1.0	U	0.9	8.6	-	1.0	1.9	U	1.6
MV-30	7/19/2023	0.4	U	1.0	7.1	-	1.0	0.3	U	1.0
MV-37	7/20/2023	1.2	U	1.1	4.0	-	0.9	-1.7	U	1.6
MV-43	7/20/2023	0.1	U	1.2	7.2	-	1.3	0.5	U	1.2
MV-50	7/19/2023	0.9	U	1.1	4.7	-	0.9	1.5	U	1.5
MV-59	7/27/2023	0.4	U	0.9	3.0	-	0.8	0.5	U	1.3
MV-64	8/24/2023	1.2	U	0.9	3.4	-	0.9	-0.1	U	1.0

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range (gross alpha) 1.4 – 2.2 pCi/L. Typical MDC range (gross beta) 1.2 – 1.8 pCi/L. MDC range (Cs-137) 1.7– 2.9 pCi/L. MDCs for TAN-2336 gross alpha (51.9 pCi/L) and gross beta (38.8 pCi/L) were larger due to high dissolved/suspended solids requiring a smaller aliquot for analysis.
*ISU-EML analyzes water samples for all common manmade gamma-emitting radionuclides. If none are detected, only the results for ^{137}Cs, the manmade gamma-emitter most likely to be detected in groundwater, are reported in this table.

Table 15. Tritium concentrations (pCi/L) for water samples, third quarter, 2023.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Test Area North				
TAN-2336	7/11/2023	298	-	70
Distant				
MV-01	7/19/2023	-30	U	60
MV-11	7/19/2023	-7	U	60
MV-18	7/20/2023	-33	U	60
MV-21	7/20/2023	7	U	60
MV-23	7/19/2023	0	U	60
MV-24A	7/19/2023	-23	U	60
MV-29	7/19/2023	-17	U	60
MV-30	7/19/2023	10	U	70
MV-37	7/20/2023	10	U	70
MV-43	7/20/2023	45	U	70
MV-50	7/19/2023	59	U	60
MV-59	7/27/2023	5	U	70
MV-64	8/24/2023	-15	U	70

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 100 – 120 pCi/L.

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

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Test Area North				
TAN-2312	6/13/2023	113[1]	-	7
Boundary				
Atomic City	5/15/2023	7	U	5
Middle-2051 (1091 ft bgs)	6/27/2023	118	-	7
Middle-2051 (749 ft bgs)	6/27/2023	121	-	7
USGS-103 (1258 ft bgs)	6/15/2023	18	-	5
USGS-105 (1072 ft bgs)	6/20/2023	125	-	8
USGS-105 (952 ft bgs)	6/20/2023	143	-	7
USGS-108 (1172 ft bgs)	6/26/2023	32	-	5
USGS-131A (616 ft bgs)	6/28/2023	612	-	22
USGS-131A (812 ft bgs)	6/28/2023	657	-	12
USGS-132 (765 ft bgs)	6/14/2023	142	-	8
USGS-137A (747 ft bgs)	6/22/2023	60	-	5
Upgradient				
USGS-027	5/02/2023	4	U	5
Distant				
MV-01	7/19/2023	-1	U	5
MV-11	7/19/2023	12	-	5
MV-18	7/20/2023	18	-	5
MV-21	7/20/2023	3	U	5
MV-23	7/19/2023	13	-	4
MV-24A	7/19/2023	16	-	4
MV-29	7/19/2023	8	-	5
MV-30	7/19/2023	10	-	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 – 13 pCi/L.
Note 1. Sample will be reanalyzed for confirmation of the result.

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

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Test Area North				
TAN-2336	7/11/2023	508	-	43

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC 1.75 pCi/L.

Table 18. Uranium isotope concentrations (pCi/L) for water samples, third 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-2336	07/11/2023	1.79	U	2.23	-0.20	U	1.34	0.00	U	1.12

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
U-234 MDC 3.69 pCi/L. U-235 MDC 2.91 pCi/L. U-238 MDC 2.33 pCi/L.

Table 19. Common ion concentrations (mg/L) in water samples, third quarter, 2023.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Fluoride		Chloride		Sulfate		Alkalinity†	
Aquifer Samples																	
Facility																	
Test Area North																	
TAN-2336	07/11/2023	69[3]	-	130[3]	-	5900[3]	-	23[3]	-	-	-	66[2]	-	2.31[2]	UJ	12400[1]	-
Distant																	
MV-01	7/19/2023	-	-	-	-	-	-	-	-	-	-	41.0[4]	-	46.2	-	172	-
MV-11	7/19/2023	-	-	-	-	-	-	-	-	-	-	65.4[3]	-	81.8[3]	-	214	-
MV-18	7/20/2023	-	-	-	-	-	-	-	-	-	-	50.8[4]	-	65.9	-	189	-
MV-21	7/20/2023	-	-	-	-	-	-	-	-	-	-	11.6	-	26.0	-	130	-
MV-23	7/19/2023	-	-	-	-	-	-	-	-	-	-	30.9	-	51.3	-	214	-
MV-24A	7/19/2023	-	-	-	-	-	-	-	-	-	-	49.9[4]	-	76.1[4]	-	239	-
MV-29	7/19/2023	-	-	-	-	-	-	-	-	-	-	16.3	-	31.3	-	121	-
MV-30	7/19/2023	-	-	-	-	-	-	-	-	-	-	48.0[4]	-	64.7	-	193	-
MV-37	7/20/2023	-	-	-	-	-	-	-	-	-	-	14.0	-	27.3	-	168	-
MV-43	7/20/2023	-	-	-	-	-	-	-	-	-	-	53.8[3]	-	68.7[3]	-	252	-
MV-50	7/19/2023	-	-	-	-	-	-	-	-	-	-	48.3[4]	-	67.3	-	183	-
MV-59	7/27/2023	-	-	-	-	-	-	-	-	-	-	13.6	-	18.5	-	114	-
MV-64	8/24/2023	-	-	-	-	-	-	-	-	-	-	16.4	-	26.4	-	120	-

Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*Samples are filtered for calcium, magnesium, sodium, and potassium.
†As $CaCO_3$.
"-" = not analyzed.
Note 1. Lab indicated that a 1:100 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:20 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 1:5 dilution of this sample was required for this analyte.
Note 4. Lab indicated that a 1:2 dilution of this sample was required for this analyte.

Table 20. Dissolved metals concentrations (µg/L) in water samples, third quarter, 2023.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Aquifer Samples																	
Facility																	
Test Area North																	
TAN-2336	07/11/2023	24[1]	UJ	1800[1]	-	360[1]	-	8500[2]	-	0	U	460[1]	-	-	-	-	-
Distant																	
MV-01	7/19/2023	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-
MV-11	7/19/2023	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
MV-18	7/20/2023	-	-	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-
MV-21	7/20/2023	-	-	-	-	3.8	-	-	-	-	-	-	-	-	-	-	-
MV-23	7/19/2023	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	-	-
MV-24A	7/19/2023	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-
MV-29	7/19/2023	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-
MV-30	7/19/2023	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-
MV-37	7/20/2023	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	-	-
MV-43	7/20/2023	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-
MV-50	7/19/2023	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-
MV-59	7/27/2023	-	-	-	-	4.3	-	-	-	-	-	-	-	-	-	-	-
MV-64	8/24/2023	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-	-	-

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
"-" = not analyzed.
Note 1. Lab indicated that a 1:25 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:5 dilution of this sample was required for this analyte.

Table 21. Dissolved nutrient concentrations (mg/L) in water samples, third quarter, 2023.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
Test Area North					
TAN-2336	07/11/2023	0.3	-	28[1]	-
Distant					
MV-01	7/19/2023	1.1	-	-	-
MV-11	7/19/2023	6.0[2]	-	-	-
MV-18	7/20/2023	3.1[4]	-	-	-
MV-21	7/20/2023	1.6[4]	-	-	-
MV-23	7/19/2023	4.6[3]	-	-	-
MV-24A	7/19/2023	5.9[2]	-	-	-
MV-29	7/19/2023	0.68	-	-	-
MV-30	7/19/2023	3.2[4]	-	-	-
MV-37	7/20/2023	2.0	-	-	-
MV-43	7/20/2023	8.0[2]	-	-	-
MV-50	7/19/2023	2.7[4]	-	-	-
MV-59	7/27/2023	0.86	-	-	-
MV-64	8/24/2023	0.54	-	-	-

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*As N.
"-" = not analyzed.
Note 1. Lab indicated that a 1:100 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 1:5 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 1:4 dilution of this sample was required for this analyte.
Note 4. Lab indicated that a 1:2 dilution of this sample was required for this analyte.

Table 22. Volatile organic compound concentrations (µg/L) in water samples, third 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	
Aquifer Samples															
Facility															
Test Area North															
TAN-2336[1]	07/11/2023	<10.0	U	<10.0	U	<10.0	U	<10.0	U	<10.0	U	<10.0	U	<10.0	U

Table 22 cont. Volatile organic compound concentrations (µg/L) in water samples, third quarter, 2023. Only VOCs detected this quarter or in the recent past are shown.

Sample Location	Sample Date	Carbon Tetrachloride		Chloroform		Chloro-methane		1,1-DCA		2-Butanone		2-Hexanone	
Aquifer Samples													
Facility													
Test Area North													
TAN-2336[1]	7/11/2023	<10.0	U	<10.0	U	<10.0	U	<10.0	U	2310	-	60.4	-

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 1:20 dilution of these samples was required for all analytes, raising the detection limits by a factor of 20.

Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants and provide independent verification of DOE's terrestrial monitoring programs. Physical soil sampling and *in-situ* gamma spectrometry are used to characterize actual deposition and accumulation of radioactive contaminants in soils. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. No *in-situ* gamma spectroscopic measurements were performed, nor were any soil samples physically collected and analyzed during the third calendar quarter of 2023.

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 23**. ^{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 23. Gamma spectroscopy analysis data for milk samples, third 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	07/18/23	1462	105	0.8	1.1	1.8
Gooding	08/15/23	1432	114	0.0	1.4	2.5
Gooding	09/20/23	1463	105	-0.2	1.1	1.9
Monteview	07/18/23	1371	110	-0.6	1.6	2.9
Monteview	08/17/23	1300	107	1.4	2.6	4.4
Monteview	08/28/23	1389	112	-0.4	3.4	5.9
Tetonia	07/29/23	1488	117	0.8	1.5	2.6
Tetonia	08/26/23	1469	119	-0.4	1.6	2.8
Tetonia	09/24/23	1390	112	-0.1	1.2	2.0
Verification Samples[1]						
Rigby	07/17/23	1321	111	0.4	2.1	3.5
Minidoka	08/21/23	1476	120	-1.6	1.7	3.0
Terreton	09/19/23	1370	111	-0.5	1.0	1.8

[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 third 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 third quarter of 2023, DEQ-INL OP submitted 65 QC samples for various radiological and non-radiological analyses (**Table 24**).

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

Blank Samples

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

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

Sample results for blank TSP filters submitted for gross alpha and gross beta screening in air for the third quarter of 2023 are presented in **Table 25**. Blank sample results for select gamma emitters in air from 47-mm TSP filter quarterly composites and 8x10-inch monthly composites are presented in **Table 26**. Blank sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from second quarter 2023 are presented in **Table 27.** Data for blank analyses used to assess data quality for tritium in

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

water vapor in air are presented in **Table 28**. Blank sample results for radiological constituents in water are presented in **Table 29**. All blank sample results met acceptance criteria for third quarter 2023.

Duplicate Samples

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

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

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

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

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

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

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

Duplicate results for radiological analyses in groundwater and surface water are presented in **Table 30**. Duplicate results for metals and common ions and nutrients in groundwater are presented in **Tables 31** and **32.** All duplicate groundwater results met acceptance criteria for the third quarter 2023.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added. They are used to assess a laboratory's analytical accuracy. The percent recovery (%R) of each spiked-sample analysis is calculated as the ratio of the spike concentration determined by the lab to the known spike concentration. DEQ-INL OP considers the lab's result to be in control if the percent recovery is 100 ± 25%. If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample may be qualified as low-biased estimates (J-), and below-MDC results may be qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples may be qualified as high-biased estimates (J+), and below-MDC results may be qualified as undetected (U). If the percent recovery of a spiked sample is <50% or >150%, the results of all associated samples may be qualified as rejected (R), except for sample results below MDC associated with a spiked-sample analysis having a percent recovery >150%, in which case the sample result remains qualified as undetected (U).

There were no spiked samples analyzed for the third quarter of 2023.

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 the third quarter 2023 are presented in **Table 33**. All three EIC control set averages, and all nine individual EIC results passed the DEQ-INL OP acceptance criterion.

Laboratory QC Issues

There were no laboratory QC issues to report in the third quarter of 2023.

DEQ-INL OP Equipment QC Issue

There were no DEQ-INL OP equipment QC issues to report in the third 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 detections and J-flagged as estimates.

Analytical QA/QC Assessment

No issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the third quarter of 2023 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 9.6% is slightly below the DEQ-INL OP minimum requirement of 10%. This is due primarily to a low number of groundwater QC sample analyses. Methodologies and data reports issued by the contracting laboratories conformed to the requirements of DEQ-INL OP during the third quarter of 2023.

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 99.7% for the third quarter of 2023 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 24**. The overall data completeness (usable results divided by the total number of field sample results expected) of 99.6% is also well above the acceptable value of 90%.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. Service reliability for air sampling equipment for the third quarter of 2023 is summarized in **Table 34**.

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

Conclusion

All data collected for the third quarter of 2023 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 99.7% and data completeness of 99.6% 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 24. Summary of analyses performed in the third 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	1	ISU-EML
		Gross beta	143	13	0	0	1	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	64	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	14	0	2	0	0	ISU-EML
		Gross beta	14	0	2	0	0	ISU-EML
		Gamma emitters	14	0	2	0	0	ISU-EML
		Tritium	14	0	2	0	0	ISU-EML
		Low-level tritium	22	1	2	0	0	ISU-EML
		Radiochemical[7]:						
		Sr-90	1	0	0	0	0	ISU-Sub
		Tc-99	0	0	0	0	0	ISU-Sub
		U-234, 235,238	1	0	0	0	0	ISU-Sub
		Pu-238, 239/240	0	0	0	0	0	ISU-Sub
		Am-241	0	0	0	0	0	ISU-Sub
		I-129	0	0	0	0	0	ISU-Sub
		Metals	14	0	2	0	0	IBL
		Common Ions	14	0	2	0	0	IBL
		Nutrients	14	0	2	0	0	IBL
		Volatile Organics	1	0	0	0	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	0	DEQ-INL OP
	EcoGamma	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			**680**	**40**	**16**	**9**	**2**	
Total QC analyses performed (blanks, duplicates, and spikes)			**65**					
Ratio of total QC analyses to total sample analyses[3]			**9.6%**					
Data usability[4], percent			**99.7%**					
Data completeness[5], percent			**99.6%**					

[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 25. Blank analysis results for gross alpha and beta in 47-mm particulate air (TSP) filters, third quarter, 2023.

Collection Period		Corrected volume (m^3)[1]	Gross alpha			Gross beta		
Start	Stop		Value	± 2 SD	MDC	Value	±2 SD	MDC
06/29/23	07/06/23	581	-0.2	0.3	0.5	-0.2	0.6	1.0
07/06/23	07/13/23	581	-0.2	0.3	0.6	-0.1	0.6	1.0
07/13/23	07/20/23	581	-0.1	0.2	0.5	-0.4	0.5	1.0
07/20/23	07/27/23	581	-0.3	0.3	0.6	-0.2	0.5	0.9
07/27/23	08/03/23	581	-0.2	0.3	0.6	0.6	0.5	0.9
08/03/23	08/10/23	581	-0.2	0.3	0.6	0.4	0.5	0.9
08/10/23	08/17/23	581	-0.2	0.3	0.5	0.4	0.6	0.9
08/17/23	08/24/23	581	-0.1	0.3	0.6	0.1	0.6	0.9
08/24/23	08/31/23	581	-0.3	0.2	0.5	0.4	0.6	0.9
08/31/23	09/07/23	581	-0.2	0.2	0.5	-0.2	0.5	1.0
09/07/23	09/14/23	581	-0.1	0.3	0.5	-0.3	0.6	1.0
09/14/23	09/21/23	581	0.1	0.3	0.5	0.2	0.6	1.0
09/21/23	09/28/23	581	-0.1	0.2	0.5	-0.4	0.6	1.0

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 26. Blank results for gamma spectrometry analysis of monthly composites of 8x10-inch TSP air filters, and quarterly composites of 47- mm TSP air filters, third 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															
July	7	26	43	-25	55	99	-8	8	14	2	3	5	5	4	7
Aug	-10	20	34	-12	29	52	-1	5	8	0	2	3	1	2	3
Sept	1	16	27	33	62	104	3	5	9	1	2	4	-1	2	3
Quarterly composite[2] of 47-mm TSP air filters															
3rd Qtr.	13	54	92	9	158	271	-2	11	19	2	5	13	1	5	8

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 27. Blank results for radiochemical analysis of 8x10-inch TSP air filters, quarterly composite samples, from second 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	0.11	0.27	0.46	0.02	0.07	0.13	0.02	0.03	0.04	0.03	0.09	0.16

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 28. Blank analysis results for tritium in water vapor from air samples, third quarter, 2023.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP233ZTR01	08/15/23	09/16/23	09/16/23	-0.02	0.06	0.10
OP233ZTR02	08/15/23	09/16/23	09/16/23	0.05	0.06	0.09
OP233ZTR03	09/26/23	10/11/23	10/11/23	0.03	0.06	0.10
OP233ZTR04	09/29/23	10/11/23	10/11/23	-0.07	0.06	0.10
Control OP233 Sink	10/04/23	10/18/23	10/18/23	0.00	0.07	0.11
Control OP233 Fridge	10/04/23	10/18/23	10/18/23	-0.03	0.06	0.10

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

Table 29. Blank analysis results (pCi/L) for radiological constituents in water, third quarter, 2023.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Tritium (low-level method)						
231W478	6/20/2023	Field	3	4	7	Yes

MDC = minimum detectable concentration.

Table 30. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, third 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										
MV-11	231W495	-0.1	1.0	231W550	0.7	1.2	-267	0.8	2.3	Yes
MV-21	231W505	1.3	1.0	231W545	1.4	1.0	-7	0.1	2.9	Yes
Gross Beta										
MV-11	231W495	8.0	1.1	231W550	7.5	1.1	6	0.5	2.3	Yes
MV-21	231W505	3.8	0.8	231W545	3.5	0.9	8	0.4	1.8	Yes
Cesium-137										
MV-11	231W495	1.5	1.4	231W550	0.5	1.1	100	1.0	2.7	Yes
MV-21	231W505	-0.2	1.1	231W545	0.4	1.5	-600	0.6	2.8	Yes
Tritium (standard method)										
MV-11	231W496	-10	60	231W551	30	60	-400	40	127	Yes
MV-21	231W506	10	60	231W546	20	60	-67	10	127	Yes
Tritium (low level method)										
M7S	231W315	379	11	231W321	410	12	-8	31	49	Yes
Atomic City	231W346	7	5	231W351	6	4	15	1	10	Yes

RPD = relative percent difference.

Table 31. Duplicate results for metals (µg/L) in groundwater, third quarter, 2023.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
MV-11	231W498	07/19/23	-	-	2.2	-	-	-	-	-
MV-11	231W553	07/19/23	-	-	2.0	-	-	-	-	-
RPD (%)			**-**	**-**	**9.5**	**-**	**-**	**-**	**-**	**-**
MV-21	231W508	07/20/23	-	-	3.8	-	-	-	-	-
MV-21	231W548	07/20/23	-	-	4.0	-	-	-	-	-
RPD (%)					**-5.1**					

RPD = relative percent difference. J = estimated value.

Table 32. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, third quarter, 2023.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus

MV-11	231W497, 499	07/19/23	-	-	-	-	-	65.4	81.8	214	6.0	-
MV-11	231W552, 554	07/19/23	-	-	-	-	-	60.0	78.2	216	6.1	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**8.6**	**4.5**	**0.9**	**-1.6**	**-**
MV-21	231W507, 509	07/20/23	-	-	-	-	-	11.6	26.0	130	1.6	-
MV-21	231W547, 549	07/20/23	-	-	-	-	-	11.6	26.0	129	1.6	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**0.8**	**0.0**	**-**

RPD = relative percent difference.

† As $CaCO_3$.

Table 33. ISU-EML electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2023.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SMD637	40.3	1.4	38.9	1.4	96.5%	Yes
SMV091	40.3	1.4	40.4	1.3	100.2%	Yes
SMV133	40.3	1.4	40.9	1.3	101.6%	Yes
				Triplicate AVG:	**99.4%**	**Yes**
SMV074	30.0	1.1	29.3	1.3	97.7%	Yes
SMD098	30.0	1.1	29.2	1.4	97.3%	Yes
SKR551	30.0	1.1	22.6	1.3	75.5%	Yes
				Triplicate AVG:	**90.2%**	**Yes**
SMV024	20.3	0.7	20.3	1.3	100.2%	Yes
SMV124	20.3	0.7	19.6	1.3	96.5%	Yes
SMV029	20.3	0.7	17.1	1.4	84.1%	Yes
				Triplicate AVG:	**93.6%**	**Yes**

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.

[1] Net measured exposure estimate includes a correction for atmospheric pressure.

Table 34. Air sampling field equipment service reliability (percent operational), third 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	92%	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, third 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	06/29/23	07/06/23	1.0	0.4	26.0	1.4
	07/06/23	07/13/23	1.1	0.4	33.7	1.5
	07/13/23	07/20/23	1.3	0.4	25.7	1.4
	07/20/23	07/27/23	1.1	0.4	26.1	1.4
	07/27/23	08/03/23	0.7	0.4	24.2	1.3
	08/03/23	08/10/23	0.8	0.4	27.1	1.4
	08/10/23	08/17/23	1.0	0.4	24.8	1.3
	08/17/23	08/24/23	0.9	0.4	23.3	1.3
	08/24/23	08/31/23	1.0	0.4	24.8	1.4
	08/31/23	09/07/23	0.6	0.4	19.4	1.2
	09/07/23	09/14/23	0.9	0.4	32.4	1.5
	09/14/23	09/21/23	0.9	0.4	34.6	1.6
	09/21/23	09/28/23	0.8	0.4	25.4	1.4
Experimental Field Station	06/29/23	07/06/23	1.1	0.4	25.6	1.4
	07/06/23	07/13/23	1.3	0.5	32.7	1.5
	07/13/23	07/20/23	1.4	0.4	24.3	1.3
	07/20/23	07/27/23	1.2	0.4	26.4	1.4
	07/27/23	08/03/23	1.0	0.4	24.1	1.3
	08/03/23	08/10/23	1.1	0.4	26.9	1.4
	08/10/23	08/17/23	1.3	0.4	25.4	1.3
	08/17/23	08/24/23	0.9	0.4	21.6	1.3
	08/24/23	08/31/23	1.6	0.9	27.6	2.3
	08/31/23	09/07/23	0.5	0.3	19.9	1.2
	09/07/23	09/14/23	1.5	0.4	31.1	1.5
	09/14/23	09/21/23	1.1	0.4	35.6	1.6
	09/21/23	09/28/23	R[1]	R	R	R
Sand Dunes Tower	06/29/23	07/06/23	0.7	0.4	23.8	1.3
	07/06/23	07/13/23	1.2	0.4	32.7	1.5
	07/13/23	07/20/23	1.3	0.4	25.6	1.3
	07/20/23	07/27/23	1.0	0.4	26.8	1.4
	07/27/23	08/03/23	0.5	0.4	19.1	1.2
	08/03/23	08/10/23	1.0	0.4	27.6	1.4
	08/10/23	08/17/23	1.0	0.4	27.5	1.4
	08/17/23	08/24/23	0.6	0.4	21.2	1.2
	08/24/23	08/31/23	0.8	0.4	24.3	1.3
	08/31/23	09/07/23	0.9	0.4	18.4	1.2
	09/07/23	09/14/23	0.5	0.3	32.0	1.5
	09/14/23	09/21/23	1.0	0.4	35.2	1.5
	09/21/23	09/28/23	1.0	0.4	24.1	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, third quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	06/29/23	07/06/23	1.2	0.4	25.7	1.4
	07/06/23	07/13/23	0.8	0.4	28.9	1.4
	07/13/23	07/20/23	1.5	0.4	24.1	1.3
	07/20/23	07/27/23	1.0	0.4	25.4	1.3
	07/27/23	08/03/23	0.9	0.4	24.6	1.3
	08/03/23	08/10/23	1.1	0.4	28.9	1.4
	08/10/23	08/17/23	1.2	0.4	27.6	1.4
	08/17/23	08/24/23	0.8	0.4	21.0	1.3
	08/24/23	08/31/23	0.9	0.4	23.2	1.3
	08/31/23	09/07/23	0.7	0.4	18.2	1.2
	09/07/23	09/14/23	0.9	0.4	32.4	1.5
	09/14/23	09/21/23	1.0	0.4	35.8	1.6
	09/21/23	09/28/23	0.8	0.4	24.6	1.4
Boundary Locations						
Atomic City	06/29/23	07/06/23	1.1	0.4	25.8	1.4
	07/06/23	07/13/23	1.5	0.5	31.6	1.5
	07/13/23	07/20/23	1.3	0.4	24.0	1.3
	07/20/23	07/27/23	1.1	0.4	25.3	1.3
	07/27/23	08/03/23	0.8	0.4	24.5	1.3
	08/03/23	08/10/23	1.0	0.4	25.4	1.3
	08/10/23	08/17/23	1.1	0.4	26.9	1.4
	08/17/23	08/24/23	0.9	0.4	23.2	1.3
	08/24/23	08/31/23	1.1	0.4	24.8	1.3
	08/31/23	09/07/23	1.0	0.4	18.3	1.2
	09/07/23	09/14/23	1.0	0.4	33.4	1.5
	09/14/23	09/21/23	1.5	0.5	36.3	1.6
	09/21/23	09/28/23	3.0	0.6	27.3	1.4
Howe	06/29/23	07/06/23	1.1	0.4	27.5	1.5
	07/06/23	07/13/23	1.1	0.5	35.0	1.6
	07/13/23	07/20/23	1.1	0.4	25.3	1.4
	07/20/23	07/27/23	1.1	0.4	19.1	1.2
	07/27/23	08/03/23	0.6	0.4	25.4	1.4
	08/03/23	08/10/23	1.0	0.4	29.1	1.5
	08/10/23	08/17/23	1.2	0.5	27.2	1.4
	08/17/23	08/24/23	0.8	0.4	21.2	1.3
	08/24/23	08/31/23	0.9	0.4	25.2	1.4
	08/31/23	09/07/23	0.6	0.4	20.7	1.3
	09/07/23	09/14/23	0.9	0.4	32.3	1.6
	09/14/23	09/21/23	0.9	0.4	32.6	1.6
	09/21/23	09/28/23	0.9	0.4	25.9	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, third quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	06/29/23	07/06/23	1.2	0.4	24.1	1.3
	07/06/23	07/13/23	0.9	0.4	30.9	1.5
	07/13/23	07/20/23	1.1	0.4	24.9	1.3
	07/20/23	07/27/23	0.8	0.4	24.2	1.3
	07/27/23	08/03/23	0.8	0.4	23.8	1.3
	08/03/23	08/10/23	0.5	0.4	24.0	1.3
	08/10/23	08/17/23	1.3	0.4	24.8	1.3
	08/17/23	08/24/23	1.0	0.4	21.8	1.3
	08/24/23	08/31/23	1.0	0.4	23.6	1.3
	08/31/23	09/07/23	0.7	0.4	17.6	1.2
	09/07/23	09/14/23	1.0	0.4	30.3	1.5
	09/14/23	09/21/23	1.2	0.4	32.8	1.5
	09/21/23	09/28/23	0.6	0.3	22.9	1.3
Mud Lake	06/29/23	07/06/23	1.0	0.4	24.0	1.3
	07/06/23	07/13/23	1.0	0.4	30.1	1.4
	07/13/23	07/20/23	1.1	0.4	22.7	1.2
	07/20/23	07/27/23	0.8	0.4	25.1	1.3
	07/27/23	08/03/23	1.2	0.4	24.3	1.3
	08/03/23	08/10/23	0.5	0.4	23.2	1.2
	08/10/23	08/17/23	1.0	0.4	22.6	1.2
	08/17/23	08/24/23	0.5	0.4	21.0	1.2
	08/24/23	08/31/23	1.0	0.4	24.9	1.4
	08/31/23	09/07/23	0.8	0.4	18.3	1.2
	09/07/23	09/14/23	1.2	0.4	30.8	1.5
	09/14/23	09/21/23	0.9	0.4	33.9	1.6
	09/21/23	09/28/23	0.9	0.4	23.4	1.4
Distant Locations						
Craters of the Moon	06/29/23	07/06/23	0.8	0.4	26.6	1.4
	07/06/23	07/13/23	1.0	0.5	35.7	1.6
	07/13/23	07/20/23	0.9	0.4	25.4	1.5
	07/20/23	07/27/23	0.8	0.4	24.1	1.3
	07/27/23	08/03/23	0.7	0.4	23.7	1.3
	08/03/23	08/10/23	1.0	0.5	27.3	1.4
	08/10/23	08/17/23	0.9	0.4	27.8	1.4
	08/17/23	08/24/23	0.9	0.4	23.3	1.4
	08/24/23	08/31/23	1.2	0.5	26.2	1.4
	08/31/23	09/07/23	0.6	0.4	19.3	1.3
	09/07/23	09/14/23	1.3	0.4	33.7	1.6
	09/14/23	09/21/23	0.7	0.4	33.9	1.6
	09/21/23	09/28/23	0.7	0.4	26.4	1.5

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, third quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[2]	06/29/23	07/06/23	1.1	0.4	25.4	1.4
	07/06/23	07/13/23	1.3	0.5	33.3	1.5
	07/13/23	07/20/23	1.4	0.4	23.4	1.3
	07/20/23	07/27/23	1.0	0.4	24.7	1.3
	07/27/23	08/03/23	1.3	0.4	24.9	1.3
	08/03/23	08/10/23	0.9	0.4	26.3	1.4
	08/10/23	08/17/23	1.4	0.5	24.5	1.4
	08/17/23	08/24/23	0.7	0.4	20.6	1.2
	08/24/23	08/31/23	1.1	0.4	24.1	1.3
	08/31/23	09/07/23	0.6	0.4	16.2	1.1
	09/07/23	09/14/23	1.1	0.4	29.0	1.4
	09/14/23	09/21/23	1.0	0.4	32.3	1.5
	09/21/23	09/28/23	1.2	0.4	23.4	1.3
Idaho Falls	06/29/23	07/06/23	1.1	0.4	24.6	1.3
	07/06/23	07/13/23	1.2	0.5	31.4	1.5
	07/13/23	07/20/23	1.2	0.4	24.7	1.3
	07/20/23	07/27/23	0.8	0.4	23.1	1.3
	07/27/23	08/03/23	0.9	0.4	25.9	1.3
	08/03/23	08/10/23	0.9	0.4	24.3	1.3
	08/10/23	08/17/23	1.3	0.4	25.4	1.3
	08/17/23	08/24/23	0.6	0.4	22.4	1.3
	08/24/23	08/31/23	1.0	0.4	24.6	1.3
	08/31/23	09/07/23	0.6	0.3	16.7	1.1
	09/07/23	09/14/23	1.1	0.4	30.7	1.5
	09/14/23	09/21/23	1.1	0.4	32.7	1.5
	09/21/23	09/28/23	0.7	0.4	23.3	1.3

Note: MDCs typically range from (0.4 to 0.6) x 10^{-3} pCi/m^3 for gross alpha and from (0.8 to 1.1) x 10^{-3} pCi/m^3 for gross beta.

[1] R – result rejected. Insufficient air volume for a valid sample, due to a scheduled power outage.
[2] Operated by Shoshone-Bannock Tribes.

Appendix B

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	13.9	2.9
Craters of the Moon	13.4	2.0
Big Lost River Rest Area	14.1, 14.9	-
Van Buren Avenue	13.6	4.0
Experimental Field Station	15.5	4.9
Main Gate	13.7	2.0
Atomic City	11.2	0.9
Taber	11.5	1.4
Blackfoot	12.1	3.0
Ft. Hall	13.1	1.5
Idaho Falls	9.4	2.1
Mud Lake/ Terreton	15.3	1.6
Monteview	12.9	2.3
Sand Dunes	14.6	2.8
Howe Met. Tower	13.8	1.7
MP282 -20	11.4	3.2
MP280 -20	13.7	4.0
MP278 -20	13.3	3.6
MP276 -20	15.1	4.0
MP274 -20	12.4	2.2
MP272 -20	13.0	3.0
MP270 -20	15.2	3.9
MP268 -20	15.7	4.1
MP266 -20	13.1	5.2
MP264 -20	13.4	1.7
MP270 -20/26	12.9, 14.4	-
MP268 -20/26	16.2	3.0
MP266 -20/26	11.7, 12.9	-
MP263 -20/26	14.3	3.2
MP261 -20/26	12.0	1.4
MP259 -20/26	13.9	3.5
MP256 -20/26	15.7, 15.7	-
MFC (EBR II)	14.3	1.7
EBR I	12.8	2.8
RWMC	12.2	1.5
CFA	15.4	1.4
CITRC (PBF)	13.7	3.6
INTEC	19.4	3.7
ATR (TRA)	11.9	2.9
NRF	14.6	3.7
TAN/SMC	9.4, 11.3	-
Mud Lake Bank of Commerce	13.4	1.9
MP43-33	15.3, 16.3	-
MP41-33	17.1	1.2
MP39-33	11.1	3.1

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP37-33	12.2	3.9
MP35-33	13.5	3.2
MP33-33	13.2	5.4
MP31-33	9.9	3.1
MP29-33	12.9	4.8
MP27-33	11.8, 13.1	-
MP25-33	9.7	0.7
MP23-33	NS[2]	NS
MP21-33	10.3	5.0
MP19-33	12.3	4.3
MP14-33	10.4	1.4
MP11-33	13.9	2.5
MP06-33	11.9	2.5
MP03-33	12.6	4.1
Base of Howe	14.2	2.9
Rover	17.5	3.3
Hamer	14.0	4.6
Sugar City	17.2, 18.5	-
Roberts	15.2	3.2
Big Southern Butte	15.6	3.2
T4 North	13.5	1.5
T4 South	14.3	3.1

[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] 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