Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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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 fourth quarter, 2021 (**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 low-volume and high-volume total suspended particulate (TSP) air samplers. The low-volume samplers, which use a 47 mm diameter filter, were introduced this quarter and will be used for gross alpha and gross beta screening in future reports. The high volume TSP data was used as the official gross alpha and gross beta measurements for the fourth quarter with the 47 mm data presented for reference. Many of the high-volume air samplers were found to be operating outside of their expected flow rate range in the fourth quarter, 2021. A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of these samplers. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements and results have been footnoted as estimates.

DEQ-INL OP is changing high-volume sampler design from a 4-inch to an 8 x 10 inch filter geometry system to improve high-volume flow rate accuracy and increase sample volume. The samplers converted to this new 8 x 10 inch system in the fourth quarter were Craters of the Moon (start date 10/14/21), Van Buren Avenue (start date 10/15/21), Big Lost River Rest Area (start date 11/3/21), Monteview (start date 11/24/21), Sand Dunes (start date 11/24/21), and Atomic City (start date 12/15/21). The remaining locations will be converted in successive quarters until all high-volume TSP samplers have been changed over.

Starting in the 1st quarter, 2022, the low-volume samples will be analyzed weekly for gross alpha and gross beta and analyzed quarterly for gamma emitting radionuclides. High-volume samples will be analyzed monthly for gamma emitting radionuclides and analyzed quarterly for Sr-89/90, Pu-238, Pu-239/Pu-240, and Am-241. Weekly gross alpha and gross beta particulate radioactivity results for 4-inch and 47-mm filters from the TSP samplers are presented in **Appendix A, Tables A-1 and A-2**, and summarized as a range of results in **Table 2**. A 4-inch diameter punch was taken for analysis of the 8 x 10 inch filters. All results are within the expected historical range.

Composites of filters collected using TSP samplers during a calendar quarter are analyzed using gamma spectrometry. Typically, gamma spectrometry results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectrometry results for the fourth quarter of 2021 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide. The less-than-MDC results for Cs-137 are also reported since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

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 4**). 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 fourth quarter of 2021.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the eleven monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported quarterly mean values are weighted based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. No air moisture sample collected during this quarter manifested a tritium concentration exceeding its MDC, and all results are well below the DEQ-INL OP action level of 150 pCi/m^3 (40 CFR 61). Atmospheric tritium concentrations and their weighted quarterly means are presented in **Table 5**.

Precipitation samples were collected at six monitoring locations during the fourth quarter of 2021. These water samples were analyzed for tritium and man-made gamma emitting radionuclides. Reported quarterly mean values are weighted based upon the volume of water obtained when more than one precipitation sample was collected during the calendar quarter. Tritium and man-made gamma emitting radionuclides were below MDCs in precipitation at all locations during the fourth quarter of 2021. 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 6**.

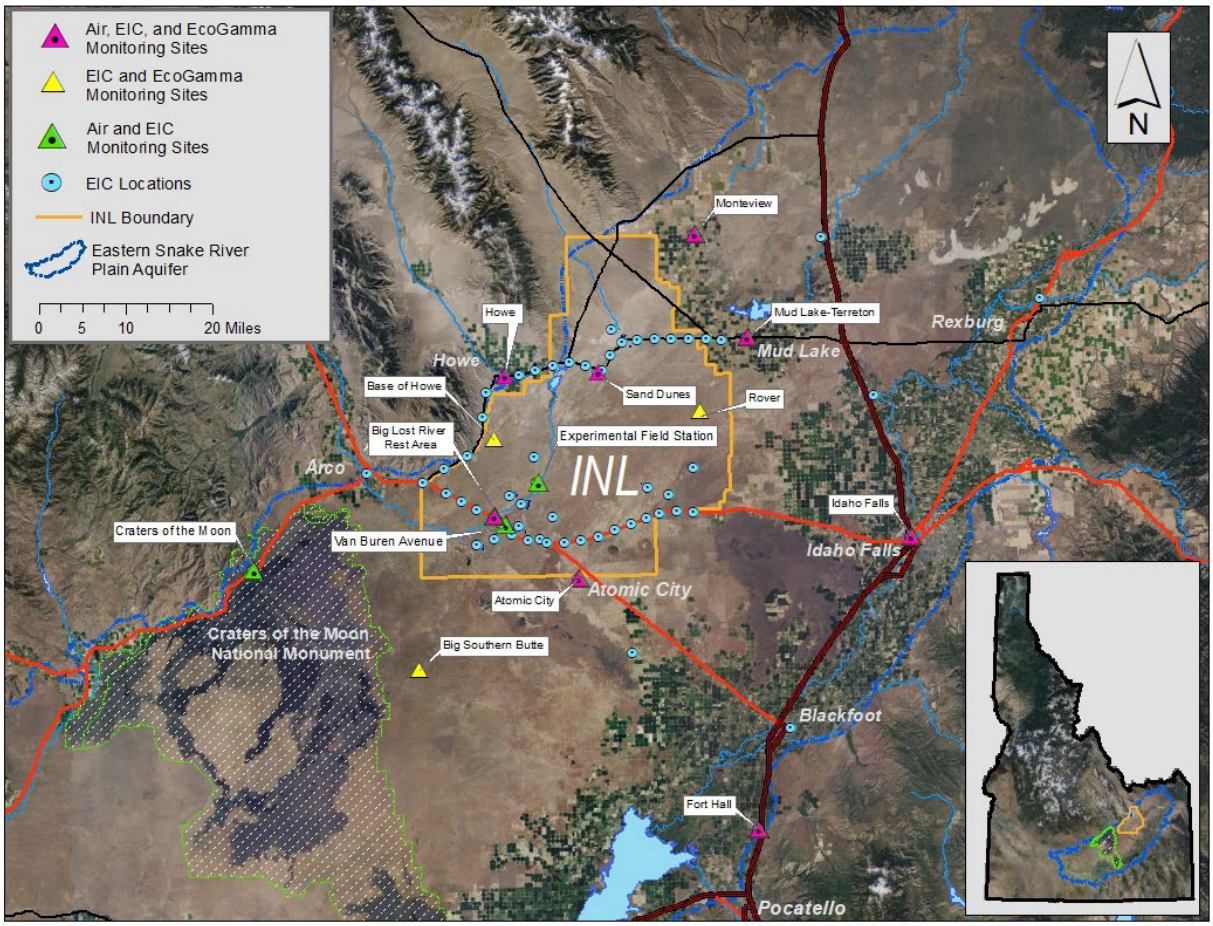

Figure 1. Air and radiation monitoring locations.

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 4-inch TSP filters, fourth quarter, 2021.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.1	-	1.1	14.1	-	43.3
Experimental Field Station	0.4 J[2]	-	1.4 J	14.4 J	-	43.0 J
Sand Dunes Tower	0.2	-	1.1	19.0	-	48.2
Van Buren Avenue	0.1	-	1.2	15.2	-	53.3
Boundary Locations						
Atomic City	0.2	-	1.9 J[2]	17.8	-	53.3
Howe	0.6 J[2]	-	2.0 J	23.9 J	-	62.1 J
Monteview	0.2	-	1.1 J[2]	19.2	-	52.8
Mud Lake	0.7 J[2]	-	1.8 J	24.1 J	-	58.2 J
Distant Locations						
Craters of the Moon	0.2	-	0.7	12.0	-	35.8
Fort Hall[1]	NS[3]	-	NS	NS	-	NS
Idaho Falls	0.3	-	1.3 J[2]	17.2	-	47.5 J
Idaho Falls Duplicate	0.3	-	1.3	13.3	-	41.4

[1]Operated by Shoshone-Bannock Tribes.
[2]Air volume was estimated. Results are J-flagged as estimates.
[3]NS – No sample.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3. MDCs typically range from (0.2 to 0.7) x 10^{-3} pCi/m^3 for gross alpha and from (0.7 to 1.8) x 10^{-3} pCi/m^3 for gross beta.

Table 3. Gamma spectrometry analysis data for 4-inch TSP filters, composite samples, fourth quarter, 2021.

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	98.6 J[3]	5.1 J	1.1 J	0.00 J	0.05 J	0.09 J
Experimental Field Station	93.9 J	5.0 J	1.2 J	0.04 J	0.05 J	0.09 J
Sand Dunes Tower	116.7 J	6.0 J	1.1 J	0.05 J	0.04 J	0.07 J
Van Buren Avenue	89.7	4.8	1.1	0.00	0.03	0.05
Boundary Locations						
Atomic City	133.4 J	6.9 J	1.2 J	0.04 J	0.04 J	0.07 J
Howe	110.4 J	5.9 J	1.4 J	0.01 J	0.04 J	0.07 J
Monteview	98.5 J	5.2 J	0.8 J	0.02 J	0.03 J	0.05 J
Mud Lake	122.4 J	6.4 J	1.4 J	0.01 J	0.05 J	0.08 J
Distant Locations						
Craters of the Moon	108.6	5.8	0.8	0.02	0.03	0.06
Fort Hall[1]	NS[4]	NS	NS	NS	NS	NS
Idaho Falls	98.5 J	5.2 J	0.9 J	0.03 J	0.03 J	0.05 J
Idaho Falls Duplicate	80.6 J	4.4 J	1.2 J	-0.02 J	0.04 J	0.07 J

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.
[3]Air volume was estimated in at least one weekly TSP sample for all locations. Results are J-flagged as estimates.
[4]NS = no samples for the entire quarter.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 4. Iodine-131 activity in weekly charcoal filter composites, fourth quarter, 2021.

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA[1]
09/29/21	10/06/21	-1.22	1.43	2.53
10/06/21	10/13/21	-0.18	1.39	2.39
10/13/21	10/20/21	-0.75	1.43	2.50
10/20/21	10/27/21	-0.76	1.07	1.92
10/27/21	11/03/21	1.33	1.37	2.23
11/03/21	11/10/21	-0.08	1.04	1.80
11/10/21	11/17/21	1.03	1.84	3.05
11/17/21	11/24/21	-0.24	1.25	2.16
11/24/21	12/01/21	-0.27	1.04	1.82
12/01/21	12/08/21	-0.28	0.99	1.74
12/08/21	12/15/21	-0.63	1.24	2.19
12/15/21	12/22/21	-0.19	1.12	1.96
12/22/21	12/29/21	0.08	1.82	3.08

[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, the highest I-131 MDA of 3.08 pCi/composite is equivalent to a maximum MDC of 5 x10^{-4} pCi/m^3.

Table 5. Tritium concentrations in air from atmospheric moisture, fourth quarter, 2021.

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	10/06/2021	10/27/2021	0.46	0.46	0.77
Big Lost River Rest Area	10/27/2021	12/08/2021	0.27	0.39	0.62
Big Lost River Rest Area	12/08/2021	12/29/2021	0.03	0.28	0.47
Big Lost River Rest Area Mean	**10/06/2021**	**12/29/2021**	**0.26**	**0.38**	**0.62**
Experimental Field Station	10/06/2021	10/27/2021	0.52	0.52	0.87
Experimental Field Station	10/27/2021	12/01/2021	0.25	0.42	0.68
Experimental Field Station	12/01/2021	12/29/2021	0.15	0.34	0.57
Experimental Field Station Mean	**10/06/2021**	**12/29/2021**	**0.29**	**0.42**	**0.69**
Sand Dunes Tower	10/06/2021	10/27/2021	0.11	0.49	0.87
Sand Dunes Tower	10/27/2021	11/24/2021	0.17	0.39	0.70
Sand Dunes Tower	11/24/2021	12/29/2021	0.09	0.29	0.49
Sand Dunes Tower Mean	**10/06/2021**	**12/29/2021**	**0.12**	**0.37**	**0.65**
Van Buren Avenue	10/06/2021	10/27/2021	0.63	0.48	0.79
Van Buren Avenue	10/27/2021	11/17/2021	0.56	0.46	0.76
Van Buren Avenue	11/17/2021	12/29/2021	0.30	0.30	0.50
Van Buren Avenue Mean	**10/06/2021**	**12/29/2021**	**0.44**	**0.38**	**0.63**
Boundary Locations					
Atomic City	10/06/21	10/27/21	0.10	0.49	0.83
Atomic City	10/27/21	12/15/21	-0.05 J[3]	0.51 J	0.87 J
Atomic City	12/15/21	12/29/21	0.14	0.27	0.46
Atomic City Mean	**10/06/2021**	**12/29/2021**	**0.04**	**0.45**	**0.77**
Howe	10/06/2021	10/27/2021	0.34	0.51	0.85
Howe	10/27/2021	12/08/2021	-0.01	0.36	0.64
Howe	12/08/2021	12/29/2021	-0.05J[2]	0.27J	0.47J
Howe Mean	**10/06/2021**	**12/29/2021**	**0.07 J**	**0.38 J**	**0.66 J**
Mud Lake	10/06/2021	10/27/2021	-0.02	0.42	0.72
Mud Lake	10/27/2021	12/08/2021	-0.18J[3]	0.40J	0.72J
Mud Lake	12/08/2021	12/29/2021	0.07	0.30	0.49
Mud Lake Mean	**10/06/2021**	**12/29/2021**	**-0.08**	**0.38**	**0.67**
Monteview	10/06/2021	10/27/2021	0.36	0.64	1.07
Monteview	10/27/2021	12/08/2021	0.26	0.39	0.70
Monteview	12/08/2021	12/29/2021	0.03	0.28	0.47
Monteview Mean	**10/06/2021**	**12/29/2021**	**0.23**	**0.43**	**0.74**
Distant Locations					
Craters of the Moon	10/06/2021	10/27/2021	0.20	0.45	0.75
Craters of the Moon	10/27/2021	11/24/2021	0.07	0.39	0.67
Craters of the Moon	11/24/2021	12/29/2021	0.03	0.31	0.51
Craters of the Moon Mean	**10/06/2021**	**12/29/2021**	**0.09**	**0.38**	**0.63**
Fort Hall[1]	10/06/2021	10/27/2021	0.29	0.53	0.88
Fort Hall	10/27/2021	11/26/2021	0.11J[3]	0.33J	0.59J
Fort Hall	11/26/2021	12/29/2021	0.07	0.34	0.56
Fort Hall Mean	**10/06/2021**	**12/29/2021**	**0.14**	**0.38**	**0.65**
Idaho Falls	10/06/2021	10/27/2021	0.39	0.51	0.84
Idaho Falls	10/27/2021	11/17/2021	0.39	0.67	1.07

Idaho Falls	11/17/2021	12/29/2021	0.07	0.33	0.55
Idaho Falls Mean	**10/06/2021**	**12/29/2021**	**0.24**	**0.47**	**0.76**

Note: Concentrations are reported in pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]Operated by Shoshone-Bannock Tribes.
[2]Air volume was estimated. Results and mean for this location are J-flagged as estimates.
[3]Air moisture weight collected in molecular sieve bead column was estimated.

Table 6. Tritium and gamma-emitting radionuclide concentrations from precipitation, fourth quarter, 2021.

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	10/06/21	10/27/21	60	90	150	-0.6	1.4	2.4
Big Lost River Rest Area	10/27/21	12/29/21	20	90	150	0.4	1.3	2.1
Big Lost River Rest Area Mean	**10/06/21**	**12/29/21**	**44**	**90**	**150**	**-0.2**	**1.4**	**2.3**
Boundary Locations								
Atomic City	10/06/21	10/27/21	50	90	150	1.5	1.7	2.7
Atomic City	10/27/21	12/29/21	30	90	150	0.3	1.7	2.9
Atomic City Mean	**10/06/21**	**12/29/21**	**43**	**90**	**150**	**1.1**	**1.7**	**2.8**
Howe	10/06/21	10/27/21	90	90	150	0.7	1.7	2.9
Howe	10/27/21	12/29/21	-20	90	150	-0.4	1.1	2.0
Howe Mean	**10/06/21**	**12/29/21**	**59**	**90**	**150**	**0.4**	**1.5**	**2.6**
Mud Lake	10/06/21	10/27/21	70	90	150	1.0	1.4	2.3
Mud Lake	10/27/21	12/29/21	20	90	150	0.5	1.4	2.4
Mud Lake Mean	**10/06/21**	**12/29/21**	**49**	**90**	**150**	**0.8**	**1.4**	**2.3**
Monteview	10/06/21	10/27/21	30	90	150	0.3	1.4	2.3
Monteview	10/27/21	12/29/21	40	90	150	-0.1	1.4	2.4
Monteview Mean	**10/06/21**	**12/29/21**	**35**	**90**	**150**	**0.1**	**1.4**	**2.3**
Distant Locations								
Idaho Falls	10/06/21	10/27/21	0	90	150	0.8	1.6	2.7
Idaho Falls	10/27/21	12/29/21	-10	90	150	-0.4	1.6	2.8
Idaho Falls Mean	**10/06/21**	**12/29/21**	**-5**	**90**	**150**	**0.3**	**1.6**	**2.7**

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 fourth quarter of 2021 (**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 dual Geiger–Müller gamma radiation monitor (**Table 8**).

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

EcoGammas are instruments capable of real-time measurements and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the EcoGammas at each location are transmitted to DEQ-INL OP and presented graphically via the

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

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

These two systems are used by DEQ-INL OP to measure external gamma radiation for various radiological monitoring objectives. **Table 8** lists the average radiation exposure rates measured by the EcoGammas for fourth quarter 2021. **Table 9** lists the EIC monitoring results for fourth quarter 2021. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 7. 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 8. Average gamma exposure rates, fourth quarter 2021, from EcoGamma network .

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average*	± 2 SD
On-site Locations		
Base of Howe	18.9	2.6
Big Lost River Rest Area	15.9	1.6
Rover[1]	17.3	1.6
Sand Dunes Tower	16.1	1.7
Boundary Locations		
Atomic City	15.9	1.7
Big Southern Butte	19.7	2.3
Big Southern Butte Duplicate[2]	15.1	1.6
Howe Met Tower	15.2	1.9
Monteview	13.7	1.6
Mud Lake / Terreton	15.2	1.6
Distant Locations		
Fort Hall	14.4	1.6
Idaho Falls	16.4	1.6

*The EcoGammas are sensitive electronic devices that can experience intermittent malfunctions and/or interference; this typically results in characteristic positive and/or negative data spikes. These aberrations are removed from the data set based on the judgement of the data analyst.
[1]Data missing 11/04/21 to 12/20/21 due to mechanical malfunction.
[2]A duplicate EcoGamma was installed at Big Southern Butte for testing on 10/05/21 and operated there for the rest of the quarter.

Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2021.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	10.7	0.5
Rest Area	13.7	3.5
Experimental Field Station	13.9	1.9
Rover	13.1	3.0
Sand Dunes	12.7	3.1
Van Buren Avenue	14.2	2.8
Boundary Locations		
Atomic City	13.0	5.3
Big Southern Butte	12.5	2.2
Howe Met. Tower	12.0	2.0
Monteview	11.4	1.7
Mud Lake/ Terreton	12.4	1.2
Distant Locations		
Craters of the Moon	10.4	4.9
Ft. Hall	9.0	1.7
Idaho Falls	8.6	1.2

[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.

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, 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), 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 fourth quarter of 2021, DEQ-INL OP sampled groundwater from the aquifer at 19 facility locations, three boundary locations, one upgradient location, and eight distant locations, three of which were springs. DEQ-INL OP also sampled water from 4 perched water locations, 2 surface water locations, and 2 wastewater locations. **Table 10** lists the sample date, co-sampler, well depth, and analyses requested for the locations sampled this quarter. Analytical results are reported in **Tables 12 through 22** and summarized below. The results of low-level tritium analyses for 12 samples collected in 2021 are reported in **Table 14** and discussed below.

Table 11 shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL). Background concentrations depend on local geology, and the concentrations of constituents at sites not influenced by INL activities may on occasion be higher than the given background ranges due to local factors and natural variability.

Gross alpha and gross beta radioactivity

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

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

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

Gross alpha and beta radioactivity were detected at low levels in most samples (**Table 12**). Gross alpha radioactivity was measured at concentrations within the known background range at all locations, except for TAN-37A, a groundwater well at TAN, where an elevated value of 15.2 ± 9.9 pCi/L was measured. Elevated gross beta concentrations were also measured at TAN with values of 1322.6 ± 32.7 pCi/L at TAN-2336, 331.6 ± 15.9 pCi/L at TAN-37A, and 91.4 ± 4.3 pCi/L at TAN-10A. An elevated gross beta concentration value of 48.4 ± 1.8 pCi/L, consistent with elevated ^{90}Sr results, was measured at perched groundwater well PW-12 at ATR. At INTEC, an elevated gross beta result of 15.8 ± 1.2 pCi/L was measured at USGS-112. The PW-12 and USGS-112 values are consistent with known ^{90}Sr or ^{99}Tc contamination in these wells. All other detectable concentrations in groundwater were consistent with historical trends.

Manmade gamma-emitting radionuclides

Manmade gamma-emitting radionuclides were detected at just one location sampled this quarter: TAN-2336. Results were above background at 3.0 ± 1.8 pCi/L, but consistent with 2021 third quarter results of 2.5 ± 1.7 pCi/L. Results for cesium-137 (^{137}Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 12**.

Tritium

Tritium was analyzed for all locations sampled this quarter (**Table 13**). Elevated tritium concentrations were observed in aquifer wells at or near ATR, INTEC, RWMC, TAN, CFA, and near the southern INL boundary at USGS-104. In the aquifer, elevated tritium concentrations ranged from 354 ± 110 at USGS-112 to 3,077 ± 200 pCi/L at TRA-07. In perched groundwater, elevated tritium concentrations ranged from 258 ± 100 pCi/L at PW-12 to 1295 ±140 pCi/L at PW-9.

One sample from third quarter and 11 samples from this quarter were analyzed for low-level tritium, with results reported in **Table 14**. The samples consisted of two facility wells, two boundary wells, two surface water locations, and six distant wells. All concentrations from surface water locations and distant sites were within the background range (0-33 pCi/L). Results from one facility well and one boundary well were above background levels: USGS-120 at 104 ± 10 pCi/L and Highway 3 at 53 ± 9 pCi/L, respectively. Results from both wells were consistent with historical trends. No backlog for low-level tritium analysis remains.

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

Five aquifer facility wells, two ATR perched groundwater wells, and one boundary well were sampled for ^{90}Sr this quarter (**Table 15).** All results from the samples exceeded the background value. At INTEC, well USGS-112 had an ^{90}Sr value of 5.5 ± 1.3 pCi/L, slightly lower than results in 2020 and USGS-115 had a detectable result, slightly above background at 0.21 ± 0.13 pCi/L. Of the three TAN wells, TAN-2336 resulted in the highest ^{90}Sr value at 480 ± 110 pCi/L, TAN-37A was 120 ± 28 pCi/L, and TAN-10-A resulted in 41 ± 9.7 pCi/L. Both TAN-37A and TAN-10A continue to follow decreasing trends. ATR perched water well PW-12 had a ^{90}Sr value of 19.2 ± 4.5 pCi/L with USGS-073 at 1.0 ± 0.44 pCi/L. Boundary well USGS-104 had a ^{90}Sr value of 1.03 ± 0.42 pCi/L (MDC = 0.63), which is above the historical range of approximately 0 – 0.2 pCi/L (less-than-MDC values). Sampling of USGS-104 is scheduled to occur in the Fall of 2022. In the meantime, a re-analysis of the original sample has been requested from the lab and the results will be available in a future quarterly report.

Four aquifer locations (i.e., three facility and one boundary) were sampled for ^{99}Tc (**Table 16**). Last year during this quarter, boundary well USGS-104 produced a value of 8.2 ± 4.2 pCi/L (MDC = 5.5 pCi/L), significantly above the historical range of about 0-2 pCi/L. Immediately, a re-analysis of the USGS-104 water sample was performed by the ISU vendor lab, producing a result of 3.7 ± 3.9 pCi/L (MDC = 6.2 pCi/L). This result was a non-detection, although it was within 3 sample standard deviations (3 SD) of the original result. USGS-104 was resampled on 6/29/21 along with CFA-2 facility well since CFA-2 is upstream of USGS-104. Both wells came back as non-detections with CFA-2 at 2.6 ± 3.1 pCi/L (MDC = 4.9 pCi/L) and USGS-104 at 1.4 ± 2.8 pCi/L (MDC = 4.9 pCi/L). This quarter, CFA-2 and USGS-104 were sampled and resulted in non-detections with CFA-2 at -2.6 ± 3.3 pCi/L (MDC = 6.6 pCi/L) and USGS-104 at 2.3 ± 3.7 pCi/L (MDC = 6.2 pCi/L). We will continue to watch these wells closely. The elevated ^{99}Tc values at INTEC wells USGS-115 at 7.9 ± 4.9 pCi/L and USGS-112 at 9.0 ± 5.1 pCi/L are within historical ranges.

Three TAN, two INTEC, and two RWMC facility locations were sampled for uranium isotopes this quarter (**Table 17**). Two wells measured at or above background (0.043-1.9 pCi/L) for ^{234}U with USGS-120 at 1.9 ± 0.42 pCi/L and TAN-10A at 2.08 ± 0.44 pCi/L. All wells, with exception of RWMC Production, produced results slightly elevated above background levels for ^{235}U. Two wells were slightly elevated above background for ^{238}U with USGS-112 at 0.72 ± 0.18 pCi/L and USGS-120 at 0.91± 0.24 pCi/L. The high ^{234}U/^{238}U ratio of 6.8 for TAN-37A and 5.9 for TAN-10A suggest that the source is anthropogenic. Results are consistent with historical data.

Two RWMC locations (RWMC Production and USGS-120) were sampled for plutonium isotopes (^{238}Pu and $^{239/240}$Pu) this quarter. One ATR location (TRA-07) and two RWMC locations (RWMC Production and USGS-120) were sampled for Americium-241 (^{241}Am) this quarter. All well results were non-detections for ^{238}Pu, $^{239/240}$Pu and ^{241}Am **(Table 18)**.

Common ions, trace metals, and nutrients

All locations except upgradient locations were sampled for chloride, chromium, sulfate, alkalinity, and dissolved nutrients (nitrate-plus-nitrite). Five locations (Alpheus Spring, Clear Spring, Bill Jones Hatchery, Minidoka Water Supply, and Shoshone Water Supply) were sampled for other common ions. Three locations (TAN-10A, TRA Cold Waste Pond, and MFC–Industrial Waste Pipe) were sampled for other common ions and trace metals. Two locations (TRA Cold Waste Pond, and MFC-Industrial Waste Pipe) were sampled for phosphorus during the quarter (**Tables19, 20, and 21**).

Most results were consistent with past results with some elevated compared to background concentrations. Similar to the 2020 values, TAN-10A had elevated concentrations above background of chloride (76.8 mg/L), barium (160 µg/L), iron (2600 µg/L, SMCL is 300 µg/L), and manganese (530 mg/L, SMCL is 50 µg/L). CFA-2, USGS-073, MFC-Industrial Waste Pipe and PW-9 had elevated concentrations above background of chloride, which were similar to prior years' results. MFC-Industrial Waste Pipe also had elevated concentrations above background of sodium (140 mg/L). The sulfate value for PW-11 was also elevated above background (144 mg/L, SMCL is 250 mg/L) . Chromium concentrations were elevated above background concentrations at TRA-07 (84 µg/L, MCL is 100 µg/L), perched groundwater well PW-9 (35 µg/L) and perched well USGS-073 (38 µg/L). USGS-073 had the highest nitrate + nitrite concentration above background at 8.8 mg/L. MFC-Industrial Waste Pipe had the highest phosphorous concentration above background at 1.0 mg/L.

Volatile organic compounds (VOCs)

VOCs were measured in aquifer wells RWMC Production and USGS-120 at or near RWMC, and TAN-10A and TAN-2312 at TAN (**Table 22**). Carbon tetrachloride, trichloroethene (TCE), and chloroform continue to be detected at RWMC Production at levels consistent with previous observations. Notable MCL exceedances and/or changes from previous measurements include:

- TAN-10A cis-1,2-DCE = 10.9 µg/L, up from 4.36 µg/L in 2020, a new maximum (MCL is 70 µg/L)
- TAN-10A PCE = 4.4 µg/L, down from 11.3 µg/L in 2020 (MCL is 5 µg/L)
- TAN-10A TCE = 23.5 µg/L, down from 41.5 µg/L in 2020 (MCL is 5 µg/L)
- USGS-120 Carbon tetrachloride = 1.75 µg/L, down from 2.35 µg/L in 2019 (MCL is 5 µg/L)
- USGS-120 TCE = 0.54 µg/L, down from 0.79 µg/L in 2020 (MCL is 5 µg/L)

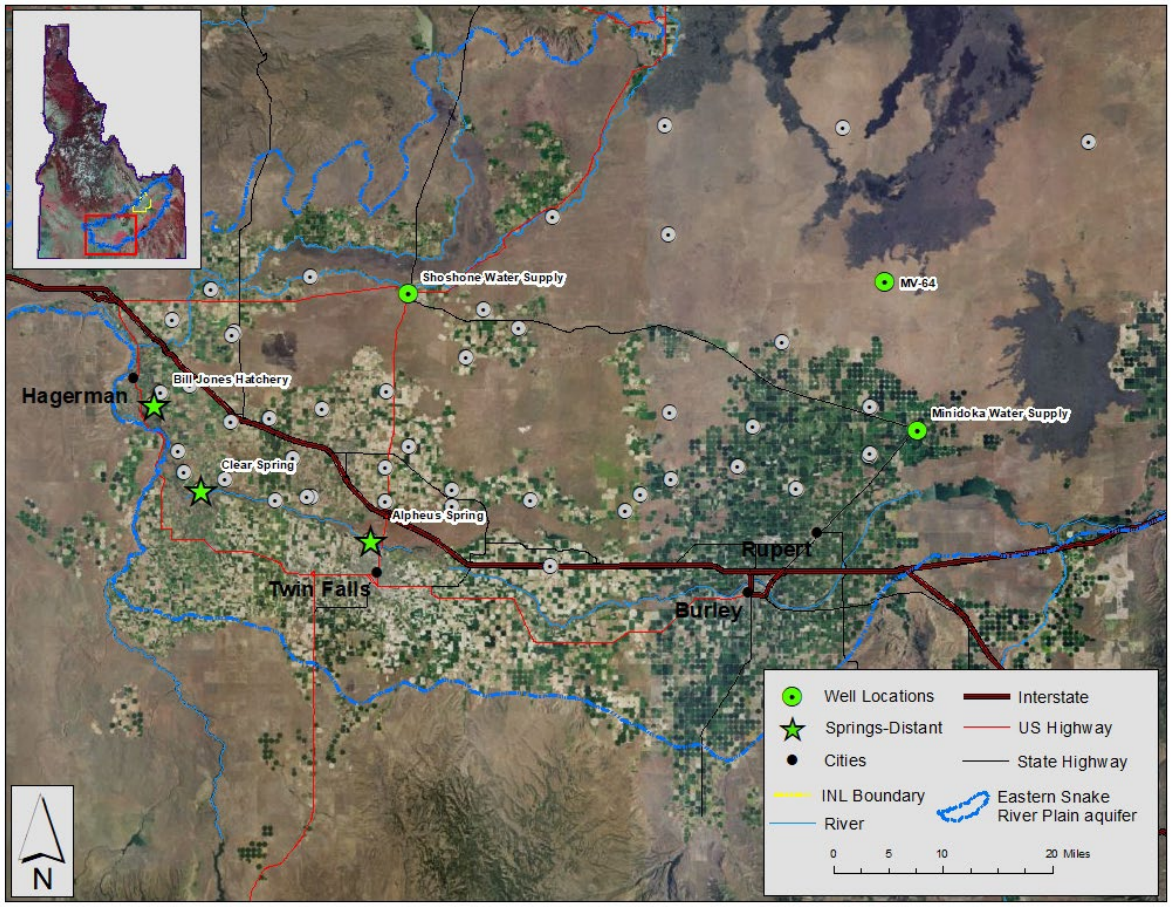

Figure 2. Distant water monitoring locations.

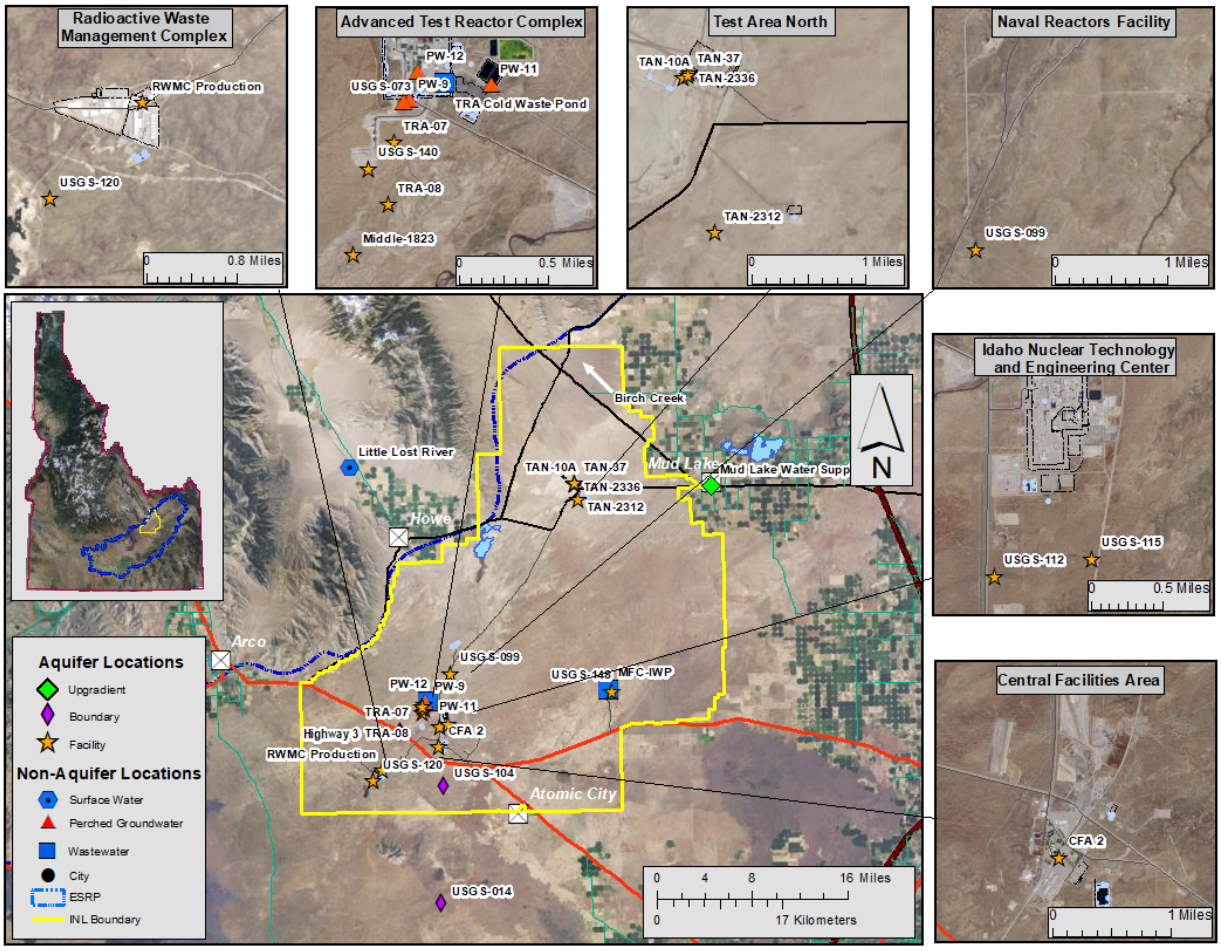

Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), surface water, and wastewater monitoring locations.

Table 10. Locations sampled for water, fourth quarter, 2021.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	11/10/2021	None	330	α, β, γ, ^{3}H
Facility				
Advanced Test Reactor Complex:				
Middle-1823	10/05/2021	IEC	729.7	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
TRA-07	10/05/2021	IEC	501	α, β, γ, ^{3}H, ^{241}Am, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
TRA-08	10/05/2021	IEC	501.5	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-140	10/18/2021	USGS	546	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Idaho Nuclear Technology and Engineering Center:				
USGS-112	10/04/2021	USGS	507	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-115	10/04/2021	USGS	581	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Radioactive Waste Management Complex:				
RWMC Production	10/19/2021	USGS	685	α, β, γ, ^{3}H, U iso, ^{241}Am, P iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
USGS-120	10/19/2021	USGS	705	α, β, γ, ^{3}H, U iso, ^{241}Am, P iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
Test Area North:				
TAN-10A	10/13/2021	IEC	250	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, VOCs
TAN-37A[1]	10/13/2021	IEC	240	α, β, γ, ^{3}H, ^{90}Sr, U iso.
TAN-2336[1]	10/13/21	IEC	255	α, β, γ, ^{3}H, ^{90}Sr, U iso.
TAN-2312	10/19/21	IEC	522	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
Central Facilities Area:				
CFA 2	10/18/2021	USGS	507	α, β, γ, ^{3}H, ^{99}Tc, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Materials and Fuels Complex:				
USGS-148	10/20/2021	USGS	680	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Naval Reactors Facility:				
USGS-099	10/21/2021	USGS	426	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Boundary				
Highway 3	10/18/2021	USGS	750	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-014	10/19/2021	USGS	751	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-104	10/18/2021	USGS	700	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Distant				
Alpheus Spring	11/08/2021	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Bill Jones Hatchery	11/08/2021	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Clear Spring	11/08/2021	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Minidoka Water Supply	11/08/2021	None	282	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Shoshone Water Supply	11/08/2021	None	715	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex:				
PW-9	10/21/2021	USGS	200	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
PW-11	10/06/2021	IEC	134.5	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
PW-12	10/06/2021	IEC	128	α, β, γ, ^{3}H, ^{90}Sr, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-073	10/21/2021	USGS	127	α, β, γ, ^{3}H, ^{90}Sr, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Surface Water				
Birch Creek	10/20/2021	USGS	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Little Lost River	10/20/2021	USGS	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Wastewater				
TRA Cold Waste Pond	10/12/2021	BEA	0	α, β, γ, ^{3}H, com. ions, trace metals, NO_3+NO_2, P
MFC-Industrial Waste Pipeline	10/14/2021 11/04/21	BEA	0	α, β, γ, ^{3}H, com. ions, trace metals, NO_3+NO_2, P

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; ^{241}Am = Americium-241; P iso. = ^{238}Pu, $^{239/240}Pu$; U iso. = ^{234}U, ^{235}U, ^{238}U; Cl^- = chloride; Cr = chromium; com. ions = calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), chloride (Cl^-), sulfate (SO_4^{2-}), alkalinity; trace metals = arsenic (As), barium (Ba), chromium (Cr), iron (Fe), manganese (Mn), lead (Pb); selenium (Se), and zinc (Zn); NO_3+NO_2 = nitrate plus nitrite; P = phosphorus, and VOCs = volatile organic compounds.
Note 1. TAN-37A and TAN-2336 are sampled every year for common ions, trace metals, nutrients, phosphorous, and VOCs. Certain wells, including TAN-37A and TAN-2336, are regularly injected with substances that, if introduced to preservatives in sampling containers, interfere with the ability of the state laboratory to analyze the sample matrix. Samples shipped to the state laboratory are now being collected at the TAN facility without addition of preservatives, which will reduce sample matrix volatility.

Table 11. 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
Uranium-234	0.043-1.9[b]	30 µg/L (total U)
Uranium-235	0-0.048[b]	
Uranium-238	0.021-0.719[b]	
Plutonium-238	0	---
Plutonium-239/240	0	---
Americium-241	0	---
Non-radiological Constituents		
Common Ions (mg/L)		
Alkalinity (as $CaCO_3$)	91-261[a]	---
Calcium	23 – 71[a]	---
Chloride	4.9 – 66.6[a]	250*
Fluoride	0.1 – 1.50[a]	4
Magnesium	10.1 – 27.4[a]	---
Potassium	1.2 – 5.8[a]	---
Sodium	2.6 – 27.0[a]	---
Sulfate	9.6 – 40.4[a]	250*
Trace Metals (µg/L)		
Arsenic	2 – 3[c]	10
Barium	50 – 70[c]	2000
Chromium	<1.0 – 5.2[a]	100
Iron	4 – 16[d]	300*
Lead	<5[c]	15
Manganese	<1 – 4[a]	50*
Selenium	<1[c]	50
Zinc	<3 – 10.5[d]	5000*
Nutrients (mg/L)		
Nitrate plus nitrite	<0.04 – 3.59[b]	10 for NO_3^-, 1 for NO_2^-
Phosphorus	<0.01 – 0.02[d]	---
Volatile Organic Compounds (µg/L)		
Tetrachloroethene (PCE)	0	5
Trichloroethene (TCE)	0	5
1,1-Dichloroethene	0	7
cis-1,2-dichloroethene	0	70
trans-1,2-dichloroethene	0	100
Vinyl chloride	0	2
Carbon tetrachloride	0	5
Chloroform	0	80[e]
Chloromethane	0	---
Methylene Chloride	0	5
Methyl Ethyl Ketone	0	---
1,1-Dichloroethane	0	---

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

Table 12. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) for water samples, fourth quarter, 2021.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Upgradient										
Mud Lake Water Supply	11/10/2021	0.7	U	0.6	3.0	-	0.9	0.6	U	1.3
Facility										
Advanced Test Reactor Complex										
Middle-1823	10/05/2021	1.8	-	0.9	1.8	-	0.9	0.0	U	1.4
TRA-07	10/05/2021	4.0	-	1.2	4.4	-	1.1	1.6	U	1.6
TRA-08	10/05/2021	1.9	-	0.9	2.0	-	0.9	-0.1	U	1.6
USGS-140	10/18/2021	1.4	U	0.9	2.7	-	0.9	1.0	U	1.6
Idaho Nuclear Technology and Engineering Center										
USGS-112	10/04/2021	2.2	-	0.9	15.8	-	1.2	1.0	U	1.8
USGS-115	10/04/2021	1.7	-	0.8	7.6	-	1.0	-0.4	U	1.3
Radioactive Waste Management Complex										
RWMC Production	10/19/2021	1.8	-	0.9	3.4	-	0.9	-1.5	U	1.6
USGS-120	10/19/2021	1.2	U	0.9	2.6	-	0.9	1.0	U	1.2
Test Area North										
TAN-10A	10/13/2021	4.9	-	2.1	91.4	-	4.3	-0.1	U	1.3
TAN-37A	10/13/2021	15.2	-	9.9	331.6	-	15.9	2.5	U	1.7
TAN-2336	10/13/2021	2.4	U	11.6	1322.6	-	32.7	3.0	-	1.8
TAN-2313	10/19/2021	1.8	-	0.9	3.3	-	0.9	-1.0	U	1.3
Central Facilities Area										
CFA 2	10/18/2021	2.1	-	1.1	4.6	-	1.1	0.4	U	1.3
Materials and Fuels Complex										
USGS-148	10/20/2021	1.1	U	0.8	4.2	-	0.9	-1.0	U	1.5
Naval Reactors Facility										
USGS-099	10/21/2021	0.4	U	0.9	1.5	-	0.9	-0.2	U	1.4
Boundary										
Highway 3	10/18/2021	2.7	-	1.0	3.2	-	0.8	0.1	U	1.1
USGS-014	10/19/2021	1.4	-	0.9	4	-	0.9	1.3	U	1.6
USGS-104	10/18/2021	2	-	0.9	2.4	-	0.9	-0.1	U	1.3
Distant										
Alpheus Spring	11/08/2021	0.7	U	1.0	7.3	-	1.2	0.6	U	1.4
Bill Jones Hatchery	11/08/2021	1.9	-	0.9	2.4	-	0.9	-0.5	U	1.6
Clear Spring	11/08/2021	2.1	-	1.0	3.3	-	1.0	-1.9	U	2.1
Minidoka Water Supply	11/08/2021	2.1	-	1.1	1.8	-	1.0	1.1	U	1.5
Shoshone Water Supply	11/08/2021	0.5	U	0.8	3.9	-	0.9	0.6	U	1.4
Other Samples										
Perched Groundwater										
Advanced Test Reactor Complex										
PW-9	10/21/2021	3.6	-	1.2	2.7	J+	1.1	0.3	U	1.2
PW-11	10/06/2021	2.4	-	1.1	6.4	-	1.1	0.5	U	1.4
PW-12	10/06/2021	3.0	-	1.1	48.4	-	1.8	1.0	U	1.5
USGS-073	10/21/2021	1.9	-	1.2	5.5	-	1.1	0.4	U	1.4
Surface Water										
Birch Creek	10/20/2021	2.2	-	0.9	1.7	-	0.9	1.1	U	1.3
Little Lost River (LLR)	10/20/2021	2.4	-	0.9	0.5	U	0.9	-0.6	U	1.4
Wastewater										
TRA Cold Waste Pond	10/12/2021	1.0	U	0.8	1.1	U	0.9	0.5	U	1.5
MFC-Industrial Waste Pipeline	10/14/2021	2.5	-	0.9	2.7	-	0.9	0.5	U	1.4

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*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.
Typical MDC range (gross alpha) 0.9 – 1.7 pCi/L. Typical MDC range (gross beta) 1.2 – 1.8 pCi/L. Higher MDCs for TAN-10A, TAN-2336, and TAN-37 were a result of high suspended/dissolved solids requiring a smaller sample for evaporation prior to counting. MDC range (Cs-137) 0.5 – 3.8 pCi/L.

Table 13. Tritium concentrations (pCi/L) for water samples, fourth quarter, 2021.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	11/10/2021	35	U	90
Facility				
Advanced Test Reactor Complex				
Middle-1823	10/05/2021	456	-	110
TRA-07	10/05/2021	3077	-	200
TRA-08	10/05/2021	708	-	120
USGS-140	10/18/2021	871	-	130
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/04/2021	354	-	110
USGS-115	10/04/2021	778	-	130
Radioactive Waste Management Complex				
RWMC Production	10/19/2021	466	-	110
USGS-120	10/19/2021	131	U	90
Test Area North				
TAN-10A	10/13/2021	380	-	110
TAN-37A	10/13/2021	459	-	110
TAN-2336	10/13/2021	610	-	120
TAN-2312	10/19/2021	0	U	90
Central Facilities Area				
CFA 2	10/18/2021	2576	-	180
Materials and Fuels Complex				
USGS-148	10/20/2021	-35	U	90
Naval Reactors Facility				
USGS-099	10/21/2021	0	U	90
Boundary				
Highway 3	10/18/2021	89	U	90
USGS-014	10/19/2021	6	U	90
USGS-104	10/18/2021	472	-	110
Distant				
Alpheus Spring	11/08/2021	89	U	90
Bill Jones Hatchery	11/08/2021	-29	U	90
Clear Spring	11/08/2021	-19	U	90
Minidoka Water Supply	11/08/2021	41	U	90
Shoshone Water Supply	11/08/2021	-6	U	90
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex				
PW-9	10/21/2021	1295	-	140
PW-11	10/06/2021	580	-	120
PW-12	10/6/2021	258	-	100
USGS-073	10/21/2021	590	-	120
Surface Water				
Birch Creek	10/20/2021	0	U	90
Little Lost River (LLR)	10/20/2021	121	U	90
Wastewater				
TRA Cold Waste Pond	10/12/2021	27	U	90
MFC-Industrial Waste Pipeline	10/14/2021	-39	U	90

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range 150-160 pCi/L.

Table 14. Low-level tritium concentrations (pCi/L) in water samples collected during 2021 and analyzed using the electrolytic enrichment method, fourth quarter of 2021.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Test Area North				
TAN-2312	10/19/2021	-4	U	6
Radioactive Waste Management Complex				
USGS-120	10/19/2021	104	-	10
Boundary				
Highway 3	10/18/2021	53	-	9
USGS-014	10/19/2021	0	U	6
Distant				
MV-64	08/23/2021	-3	U	7
Alpheus Spring	11/08/2021	10	U	7
Bill Jones Hatchery	11/08/2021	0	U	7
Clear Spring	11/08/2021	3	U	7
Minidoka Water Supply	11/08/2021	8	U	7
Shoshone Water Supply	11/08/2021	12	-	8
Other Samples				
Surface Water				
Birch Creek	10/20/2021	9	U	7
Little Lost River (LLR)	10/20/2021	11	-	7

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively. ft bgs = feet below ground surface.
MDC range 11 - 12 pCi/L.

Table 15. Strontium-90 concentrations (pCi/L) for water samples, fourth quarter, 2021.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/04/2021	5.5	-	1.3
USGS-115	10/04/2021	0.21	-	0.13
Test Area North				
TAN-10A	10/13/2021	41.0	-	9.7
TAN-37A	10/13/2021	120.0	-	28.0
TAN-2336	10/13/2021	480.0	-	110.0
Boundary				
USGS-104	10/18/2021	1.03	-	0.42
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex				
PW-12	10/06/2021	19.2	-	4.5
USGS-073	10/21/2021	1.0	-	0.44

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range 0 – 0.71 pCi/L.

Table 16. Technetium-99 concentrations (pCi/L) for water samples, fourth quarter, 2021.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/04/2021	9.0	-	5.1
USGS-115	10/04/2021	7.9	-	4.9
Central Facilities Area				
CFA-2	10/18/2021	-2.6	U	3.3
Boundary				
USGS-104	10/18/2021	2.3	U	3.7

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 6.2 – 7.2 pCi/L.

Table 17. Uranium isotope concentrations (pCi/L) for water samples, fourth quarter, 2021.

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-10A	10/13/2021	2.08	-	0.44	0.078	J#	0.06	0.35	-	0.13
TAN-37A	10/13/2021	1.3	-	0.27	0.075	J#	0.05	0.189	-	0.079
TAN-2336	10/13/2021	0.51	-	0.2	0.063	U	0.079	0.16	J#	0.11
Idaho Nuclear Technology and Engineering Center										
USGS-112	10/04/2021	1.59	-	0.32	0.054	J#	0.043	0.72	-	0.18
USGS-115	10/04/2021	0.59	-	0.15	0.08		0.051	0.35	-	0.11
Radioactive Waste Management Complex										
RWMC Production	10/19/2021	1.48	-	0.34	0.04	U	0.045	0.57	-	0.17
USGS-120	10/19/2021	1.9	-	0.42	0.099	J#	0.074	0.91	-	0.24

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
Result is >MDC and >2SD but <3SD and is therefore considered questionable and J-flagged as an estimate.
MDC range (U-234) 0.04 – 0.1 pCi/L. MDC range (U-235) 0.03 – 0.12 pCi/L. MDC range (U-238) 0.04 – 0.12 pCi/L.

Table 18. Plutonium isotope and Americium-241 concentrations (pCi/L) for water samples, fourth quarter, 2021.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240			Americium-241		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Radioactive Waste Management Complex										
RWMC Production	10/19/2021	0.009	U	0.013	0.00	U	0.016	0.00	U	0.014
USGS-120	10/19/2021	0.002	U	0.011	0.002	U	0.012	0.007	U	0.015
Advanced Test Reactor Complex										
TRA-07	10/05/21	-	-	-	-	-	-	-0.0074	U	0.0097

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC (Pu-238) 0.021pCi/L. MDC range (Pu-239/240) 0.025 – 0.032 pCi/L. MDC range (Am-241) 0.027 – 0.03 pCi/L.

Table 19. Common ion concentrations (mg/L) in water samples, fourth quarter, 2021.

Sample Location	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity†
Aquifer Samples									
Facility									
Advanced Test Reactor Complex									
Middle-1823	10/05/2021	-	-	-	-	-	11.2	32.2	169
TRA-07	10/05/2021	-	-	-	-	-	22.0	141.0[2]	137
TRA-08	10/05/2021	-	-	-	-	-	11.6	43.7	154
USGS-140	10/18/2021	-	-	-	-	-	14.1	34.8	163
Idaho Nuclear Technology and Engineering Center									
USGS-112	10/04/2021	-	-	-	-	-	14.6	26.8	147
USGS-115	10/04/2021	-	-	-	-	-	44.0[1]	24.9	110
Radioactive Waste Management Complex									
RWMC Production	10/19/2021	-	-	-	-	-	25.7	29.8	140
USGS-120	10/19/2021	-	-	-	-	-	18.0	34.9	147
Test Area North									
TAN-10A	10/13/2021	60.0	18.0	35.0	3.5	-	76.8[2]	25.9	190
TAN-37A[4]	10/13/2021	-	-	-	-	-	-	-	-
TAN-2312	10/19/2021	-	-	-	-	-	8.58	25.2	125
TAN-2336[4]	10/13/2021	-	-	-	-	-	-	-	-
Central Facilities Area									
CFA 2	10/18/2021	-	-	-	-	-	136.0[2]	47.0	135
Materials and Fuels Complex									
USGS-148	10/20/2021	-	-	-	-	-	15.9	17.6	132
Naval Reactors Facility									
USGS-099	10/21/2021	-	-	-	-	-	19.6	26.4	195
Boundary									
Highway 3	10/18/2021	-	-	-	-	-	6.3	21.1	144
USGS-014	10/19/2021	-	-	-	-	-	21.4	22.1	139
USGS-104	10/18/2021	-	-	-	-	-	15.1	21.4	124
Distant									
Alpheus Spring	11/08/2021	54.0	20.0	34.0	6.4	-	41.3[1]	56.8	181
Clear Spring	11/08/2021	44.0	19.0	26.0	4.1	-	32.7	47.5	154
Bill Jones Hatchery	11/08/2021	30.0	16.0	16.0	3.5	-	11.4	26.3	133
Shoshone Water Supply	11/08/2021	40.0	14.0	14.0	2.9	-	6.18	17.2	166
Minidoka Water Supply	11/08/2021	47.0	17.0	21.0	3.6	-	37.1[1]	46.1	141
Other Samples									
Perched Groundwater									
Advanced Test Reactor Complex									
PW-09	10/21/2021	-	-	-	-	-	88.0[2]	47.4	114
PW-11	10/06/2021	-	-	-	-	-	17.4	144.0[2]	156
PW-12	10/06/2021	-	-	-	-	-	43.2[1]	22.8	172
USGS-073	10/21/2021	-	-	-	-	-	95.9[2]	34.0	185
Surface Water									
Birch Creek	10/20/2021	-	-	-	-	-	4.77	25.5	147
Little Lost River	10/20/2021	-	-	-	-	-	7.41	17.7	160
Wastewater									
TRA Cold Waste Pond	10/12/2021	43.0	16.0	7.9	1.6	-	10.2	20.9	166
MFC-Industrial Waste Pipeline	11/04/2021	48.0	15.0	140.0	4.5	-	239.0[3]	23.6	167

Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
† As $CaCO_3$.
"-" = not analyzed.
Note 1. Lab indicated that a 2:1 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 5:1 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 10:1 dilution of this sample was required for this analyte.
Note 4. Lab was not able to analyze for common ions due to sample matrix interference.

Table 20. Dissolved metals concentrations (µg/L) in water samples, fourth quarter, 2021.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Aquifer Samples																	
Facility																	
Advanced Test Reactor Complex																	
Middle-1823	10/05/2021	-	-	-	-	9.9		-	-	-	-	-	-	-	-	-	-
TRA-07	10/05/2021	-	-	-	-	84.0		-	-	-	-	-	-	-	-	-	-
TRA-08	10/05/2021	-	-	-	-	18.0		-	-	-	-	-	-	-	-	-	-
USGS-140	10/18/2021	-	-	-	-	17.0		-	-	-	-	-	-	-	-	-	-
Idaho Nuclear Technology and Engineering Center																	
USGS-112	10/04/2021	-	-	-	-	9.2		-	-	-	-	-	-	-	-	-	-
USGS-115	10/04/2021	-	-	-	-	13.0		-	-	-	-	-	-	-	-	-	-
Radioactive Waste Management Complex																	
RWMC Production	10/19/2021	-	-	-	-	12.0		-	-	-	-	-	-	-	-	-	-
USGS-120	10/19/2021	-	-	-	-	8.8		-	-	-	-	-	-	-	-	-	-
Test Area North																	
TAN-10A	10/13/2021	0.27	UJ	160.0	-	1.8	-	2600.0	-	0	U	530.0[2]	-	-	-	-	-
TAN-37A[1]	10/13/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAN-2312	10/19/2021	-	-	-	-	7.0	-	-	-	-	-	-	-	-	-	-	-
TAN-2336[1]	10/13/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Central Facilities Area																	
CFA 2	10/18/2021	-	-	-	-	11.0		-	-	-	-	-	-	-	-	-	-
Materials and Fuels Complex																	
USGS-148	10/20/2021	-	-	-	-	2.1		-	-	-	-	-	-	-	-	-	-
Naval Reactors Facility																	
USGS-099	10/21/2021	-	-	-	-	6.1	-	-	-	-	-	-	-	-	-	-	-
Boundary																	
Highway 3	10/18/2021	-	-	-	-	2.3	-	-	-	-	-	-	-	-	-	-	-
USGS-014	10/19/2021	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-
USGS-104	10/18/2021	-	-	-	-	8.2	-	-	-	-	-	-	-	-	-	-	-
Distant																	
Alpheus Spring	11/08/2021	-	-	-	-	1.3	-	-	-	-	-	-	-	-	-	-	-
Clear Spring	11/08/2021	-	-	-	-	2.4	-	-	-	-	-	-	-	-	-	-	-
Bill Jones Hatchery	11/08/2021	-	-	-	-	3.4	-	-	-	-	-	-	-	-	-	-	-
Shoshone Water Supply	11/08/2021	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
Minidoka Water Supply	11/08/2021	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-
Other Samples																	
Perched Groundwater																	
Advanced Test Reactor Complex																	
PW-09	10/21/2021	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-
PW-11	10/06/2021	-	-	-	-	15.0	-	-	-	-	-	-	-	-	-	-	-
PW-12	10/06/2021	-	-	-	-	9.9	-	-	-	-	-	-	-	-	-	-	-
USGS-073	10/21/2021	-	-	-	-	38.0	-	-	-	-	-	-	-	-	-	-	-
Surface Water																	
Birch Creek	10/20/2021	-	-	-	-	0.79	UJ	-	-	-	-	-	-	-	-	-	-
Little Lost River	10/20/2021	-	-	-	-	1.2	U	-	-	-	-	-	-	-	-	-	-
TRA Cold Waste Pond	10/12/2021	1.5	UJ	49.0	-	4.2	-	1.8	UJ	0.0	U	0.091	UJ	0.0	U	-	-
MFC-Industrial Waste Pipeline	11/04/2021	2.5	-	51.0	-	2.4	-	18	-	0.4	UJ	4.1	-	0.78	UJ	-	-

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 was not able to analyze for metals due to sample matrix interference.
Note 2. Lab indicated that a 5:1 dilution of this sample was required for this analyte.

Table 21. Dissolved nutrient concentrations (mg/L) in water samples, fourth quarter, 2021.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
Advanced Test Reactor Complex					
Middle-1823	10/05/2021	0.98	-	-	-
TRA-07	10/05/2021	1.0	-	-	-
TRA-08	10/05/2021	0.99	-	-	-
USGS-140	10/18/2021	1.1	-	-	-
Idaho Nuclear Technology and Engineering Center					
USGS-112	10/04/2021	0.92	-	-	-
USGS-115	10/04/2021	1.5	-	-	-
Radioactive Waste Management Complex					
RWMC Production	10/19/2021	1.0	-	-	-
USGS-120	10/19/2021	0.78	-	-	-
Test Area North					
TAN-10A	10/13/2021	0.18	-	-	-
TAN-37A[4]	10/13/2021	-	-	-	-
TAN-2312	10/19/2021	0.75	-	-	-
TAN-2336[4]	10/13/2021	-	-	-	-
Central Facilities Area					
CFA-2	10/18/2021	4.0[1]	-	-	-
Materials and Fuels Complex					
USGS-148	10/20/2021	2.5[1]	-	-	-
Naval Reactors Facility					
USGS-099	10/21/2021	1.7	-	-	-
Boundary					
Highway 3	10/18/2021	0.54	-	-	-
USGS-014	10/19/2021	1.3	-	-	-
USGS-104	10/18/2021	0.86	-	-	-
Distant					
Alpheus Spring	11/08/2021	2.2[1]	-	-	-
Clear Spring	11/08/2021	2.2[1]	-	-	-
Bill Jones Hatchery	11/08/2021	1.4	-	-	-
Shoshone Water Supply	11/08/2021	1.3	-	-	-
Minidoka Water Supply	11/08/2021	1.3[1]	-	-	-
Other Samples					
Perched Groundwater					
Advanced Test Reactor Complex					
PW-9	10/21/2021	4.2[2]	-	-	-
PW-11	10/06/2021	1.5	-	-	-
PW-12	10/06/2021	1.2	-	-	-
USGS-073	10/21/2021	8.8[3]	-	-	-
Surface Water					
Birch Creek	10/20/2021	0.22	-	-	-
Little Lost River (LLR)	10/20/2021	0.31	-	-	-
Wastewater					
TRA Cold Waste Pond	10/12/2021	0.9	-	0.018	-
MFC-Industrial Waste Pipeline	11/04/2021	3.2[1]	-	1.0[2]	-

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 2:1 dilution of this sample was required for this analyte.

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

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

Note 4. Lab was not able to analyze for nutrients due to sample matrix interference.

Table 22. Volatile organic compound concentrations (µg/L) in water samples, fourth quarter, 2021. 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	
RWMC Production	10/19/2021	<0.50	U	2.51	-	<0.50	U	<0.50	U	<0.50	U	<0.50	U
USGS-120	10/19/2021	<0.50	U	0.54	-	<0.50	U	<0.50	U	<0.50	U	<0.50	U
TAN-10A	10/13/2021	4.4	-	23.5	-	<0.50	U	10.9	-	<0.50	U	<0.50	U
TAN- 2312	10/19/2021	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U
TAN-2336[1]	10/13/2021	-	-	-	-	-	-	-	-	-		-	-
TAN-37A[1]	10/13/2021	-	-	-	-	-	-	-	-	-		-	-

Table 22. continued - Volatile organic compound concentrations (µg/L) in water samples, fourth quarter, 2021. Only VOCs detected this quarter or in the recent past are shown.

Sample Location	Sample Date	Carbon tetrachloride		Chloroform		Chloro-methane		1,1-DCA	
RWMC Production	10/19/2021	4.81	-	1.52	-	<0.50	U	<0.50	U
USGS-120	10/19/2021	1.75	-	<0.50	U	<0.50	U	<0.50	U
TAN-10A	10/13/2021	<0.50 U	U	<0.50	U	<0.50	U	<0.50	U
TAN- 2312	10/19/2021	<0.50 U	U	<0.50	U	<0.50	U	<0.50	U
TAN-2336[1]	10/13/2021	-	-	-	-	-	-	-	-
TAN-37A[1]	10/13/2021	-	-	-	-	-	-	-	-

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.
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 was not able to analyze for VOCs due to sample matrix interference.

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 physical soil samples were collected during the fourth calendar quarter of 2021.

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, fourth quarter, 2021.

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	10/21/21	1721	142	1.1	1.4	2.3
	11/22/21	1498	131	0.2	2.1	3.4
	12/15/21	1373	84	2.5	2.9	4.8
Verification Samples[1]						
Dietrich	10/05/21	1456	87	0.1	1.7	2.9
Terreton	10/07/21	1417	126	0.2	1.3	2.1
Minidoka	11/02/21	1390	114	0.0	1.4	2.4
Rigby	11/02/21	1740	144	0.4	1.3	2.2
Howe	12/06/21	1775	100	-1.4	2.1	3.7
Dietrich	12/07/21	1489	89	0.8	2.2	3.6

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

Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation used to acquire gamma spectra produced by gamma-emitting radionuclides in soil. Concentrations of these nuclides are then calculated from the spectra using models for the depth distribution of the nuclide and resultant gamma ray attenuation in the soil column. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons.

Starting in 2021, INL OP has elected to change the spectrum analysis modeling geometry from a negative exponential to a uniform homogeneous distribution with depth as recommended by NCRP 129. Air dispersed anthropogenic nuclides observed in nature likely follow a negative exponential distribution with

the highest concentration at the soil surface and a decrease in concentration with depth but with the wide range of soil types, weathering, and disturbances from blowing wind in east Idaho an assumed uniform distribution provides a technique to average out the variations caused by these factors and provides a more conservative concentration estimate to alarm us of an upset condition. The ratio of the concentration using the current uniform distribution to the concentration using the previous negative exponential distribution is 2.1. INL OP will continue to evaluate select locations using the historical negative exponential distribution until a reasonable database of yearly measurements can be achieved with the new analysis geometry, but we will no longer be reporting these values.

In-Situ gamma spectroscopic measurements were performed at 41 locations (see **Figure 4**) during the fourth calendar quarter of 2021. ^{137}Cs was the only man made gamma emitting radionuclide detected. Analysis results for ^{137}Cs concentrations for *in-situ* soil monitoring are shown in **Table 24**.

Table 24. *In-Situ* gamma spectroscopic analysis results (^{137}Cs) for soil, fourth quarter, 2021.

Location	Date Acquired	Concentration[1]	2-sigma	MDA
Boundary Sampling Locations				
Big Southern Butte	11/30/2021	0.217	0.049	0.021
ESER Soil Site Monteview	12/08/2021	0.354	0.093	0.024
Monteview air station	12/08/2021	0.148	0.071	0.025
ESER Soil Site Mud Lake #2	12/08/2021	0.449	0.106	0.029
Mud Lake Air station	12/09/2021	0.109	0.067	0.023
Howe Met Tower	12/09/2021	0.257	0.071	0.020
ESER Soil Site FAA tower	12/01/2021	0.505	0.081	0.024
Large Grid 18-4	11/30/2021	0.291	0.052	0.022
Frenchman's Cabin Soil Site	11/30/2021	0.400	0.081	0.023
Large Grid 12-4	11/30/2021	0.332	0.049	0.015
Large Grid 12-5	11/30/2021	0.433	0.081	0.024
ESER Soil Site Butte City	12/10/2021	0.357	0.046	0.017
ESER Soil Site Atomic City	12/10/2021	0.510	0.097	0.028
Atomic City Air station	12/10/2021	0.405	0.101	0.023
ESER Soil Site Reno Ranch	12/03/2021	0.564	0.082	0.023
Distant Sampling Locations				
IF air station[2]	11/29/2021	0.070	0.046	0.022
IF CMS[3]	11/29/2021	0.186	0.085	0.022
St Anthony	11/29/2021	0.344	0.084	0.027
Sage Junction	11/29/2021	0.536	0.079	0.018
Roberts Met Tower	11/29/2021	0.275	0.066	0.018
ESER Soil Site Carey	12/10/2021	0.560	0.089	0.025
ESER soil site Blackfoot	12/02/2021	0.363	0.093	0.026
Crystal Ice Caves	12/02/2021	0.454	0.080	0.024
On site Sampling Locations				
Van Buren Air station	12/09/2021	0.260	0.055	0.024
Rest Area A	12/09/2021	0.405	0.183	0.029
Base of Howe	12/09/2021	0.166	0.047	0.021
ESER Soil Site Howe	12/09/2021	0.502	0.106	0.025
Large Grid 18-8	12/01/2021	0.531	0.104	0.031
Large Grid 24-2	12/01/2021	0.459	0.073	0.024
Large Grid 24-7 A	12/01/2021	0.237	0.091	0.023
Large Grid 18-3	12/01/2021	0.369	0.087	0.024
Rover	12/01/2021	0.202	0.067	0.023
Large Grid 24-9	12/03/2021	0.512	0.088	0.021
Large Grid 24-8	12/03/2021	0.478	0.081	0.023
Large Grid 18-1	12/03/2021	0.282	0.077	0.025
Large Grid 18-7	12/03/2021	0.296	0.094	0.023
Large Grid 30-1	12/03/2021	0.372	0.042	0.014
Sand Dunes Air station	12/08/2021	0.287	0.065	0.021
Large Grid 6-3	12/02/2021	0.668	0.208	0.032
EFS field air station	12/02/2021	0.706	0.095	0.028
INL Main Gate	12/09/2021	0.401	0.106	0.027

[1]Concentrations are reported in pCi/g.
[2]DEQ-INL OP HPIC air monitoring station near Idaho Falls, ID.
[3]DEQ-INL OP HPIC Community Monitoring Station (CMS) near John's Hole Bridge Idaho Falls, ID.

The average Cesium-137 value was 0.38 picocuries per gram (pCi/g) with a minimum value of 0.07 pCi/g and a maximum of 0.71 pCi/g, well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g (NCRP Report 129).

Based upon terrestrial radiological measurements of soil and milk, there were no clearly discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides

observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons and possibly INL operations.

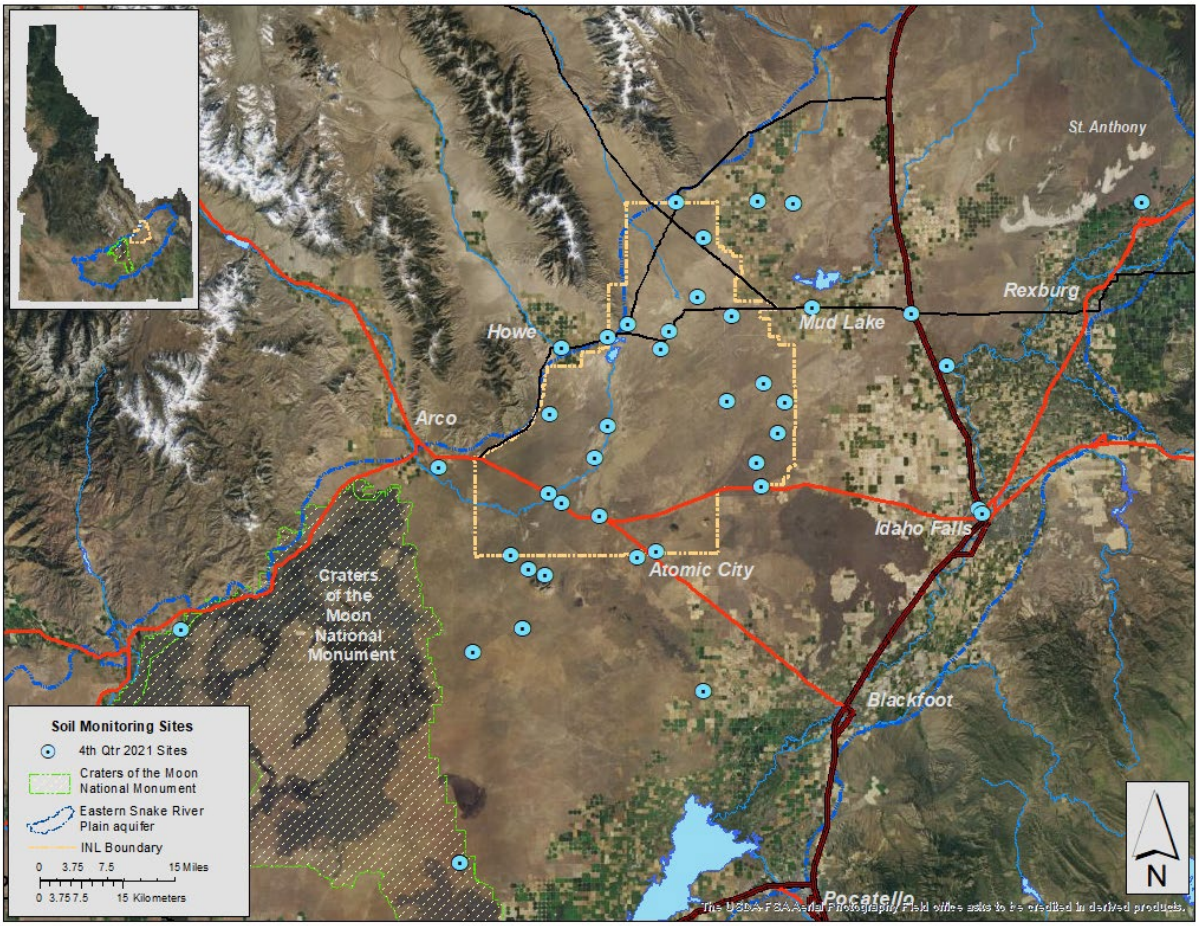

Figure 4. *In-situ* soil monitoring sites, fourth quarter 2021.

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 fourth quarter of 2021. 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

fourth quarter of 2021, DEQ-INL OP submitted 131 QC samples for various radiological and non-radiological analyses (**Table 25**).

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 for 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 4-inch and 47-mm TSP filters submitted for gross alpha and gross beta screening in air for the fourth quarter of 2021 are presented in **Table 26**. Blank sample results for select gamma emitters in air from 4-inch and 47-mm TSP filters composited for the quarter are presented in **Table 27**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 28**. Blank sample results for radiological analytes in groundwater are presented in **Table 29**. Blank sample results for metals, common ions and nutrients, and VOCs in groundwater are presented in **Tables 30, 31, and 32.**

The TSP 4-inch filter blank gross beta result for the week of 12/15-12/22/21 exceeded the MDC. The associated TSP 4-inch filter gross beta field results for that week were qualified (J+) as biased high estimates. The TSP 47-mm blank gross alpha result for the week of 12/15 – 12/22/21 minimally exceeded the MDC. The associated TSP 47-mm filter gross alpha field results for that week were qualified (J+) as biased high estimates. A water field blank gross beta analysis exceeded the MDC. Associated field samples were qualified (J+) as biased high estimates. A water field blank manganese result exceeded the MDC. The associated field sample was a non-detection qualified as UJ.

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.

[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).

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 agree 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 33**. Duplicate results for metals, common ions and nutrients, and VOCs in groundwater are presented in **Tables 34, 35,** and **36.** Duplicate results for *in-situ* analyses of gamma emitting radionuclides in soil are presented in **Table 37.**

All duplicate results passed acceptance criteria in the fourth quarter of 2021.

Spiked Samples

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

Spiked sample results for metals, common ions and nutrients, and VOCs in groundwater are presented in **Tables 38, 39,** and **40.**

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) 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%.

As an additional quality control check for fourth quarter, the irradiated EIC voltages were read on two SPER-1E readers (serial numbers E0988 and E1365). All results were acceptable, and results from the two readers were in excellent agreement. The irradiation results for fourth quarter 2021 are presented in **Tables 41 and 42**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets.

All spike sample results passed acceptance criteria in the fourth quarter of 2021.

Laboratory QC Issues

There were no laboratory QC issues to report in the fourth quarter of 2021.

DEQ-INL OP Equipment QC Issue

Many of the TSP air samplers were found to be operating outside of their expected flow rate range in the fourth quarter, 2021. A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of these samplers. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements, and results are considered (usable) estimates.

Qualification of Low Level Sample Results

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

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

Analytical QA/QC Assessment

Other than those discussed above, no issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the fourth quarter of 2021 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 12.5% is acceptable and above the DEQ-INL OP minimum requirement of 10%. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the fourth quarter of 2021.

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 100% for the fourth quarter of 2021 is well above the minimum acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 25**. The overall data completeness (usable results divided by the total number of field sample results expected) of 95.4% is also above the acceptable value of 90%. Usable results expected but not obtained were due primarily to TSP samplers being out of service, as discussed directly below.

Preventative Maintenance and Equipment Reliability

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

All equipment was calibrated and checked according to prescribed periodicity. The Craters of the Moon Station 4-inch TSP sampler power was out of service for the time periods 9/29-10/13/21 and 10/20-11/03/21. The Fort Hall 4-inch TSP sampler was out of service for repair for the entire quarter. The Idaho Falls Duplicate 4-inch TSP sampler was out of service from 12/15/21 to 12/29/21. The Atomic City 47-mm TSP sampler was out of service from 11/10/21 to 11/24/21. Service reliability for air sampling equipment for the fourth quarter of 2021 is summarized in **Table 43**.

Conclusion

All data collected for the fourth quarter of 2021 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 100% and data completeness of 95.4% are above the minimum acceptable value of 90% for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 25. Summary of the analyses performed in the fourth quarter, 2021.

Media Sampled	Collection Device	Analyte	Sample Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected[1]	Analyzing Lab[2]
Air								
Particulate	4-inch filter	Gross alpha	279	28	0	0	0	ISU-EML
		Gross beta	279	28	0	0	0	ISU-EML
		Gamma emitters	22	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	33	6	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	12	0	0	0	0	ISU-EML
		Gamma emitters	12	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	32	2	4	0	0	ISU-EML
		Gross beta	32	2	4	0	0	ISU-EML
		Gamma emitters	32	2	4	0	0	ISU-EML
		Tritium	32	2	4	0	0	ISU-EML
		Low-level tritium	12	0	3	0	0	ISU-EML
		Radiochemical[6]	24	0	3	0	0	ISU Sub
		Metals	29	2	4	1	0	IBL
		Common Ions	29	2	4	1	0	IBL
		Nutrients	29	2	4	1	0	IBL
		Volatile Organics	4	1	1	1	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	9	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	41	0	5	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	67	0	0	9	0	DEQ-INL OP
	HPICs/Eco Gammas	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			**1033**	**78**	**40**	**13**	**0**	
Total QC analyses performed (blanks, duplicates, and spikes)			**131**					
Ratio of total QC analyses to total sample analyses[3]			**12.7%**					
Data usability[4], percent			**100%**					
Data completeness[5], percent			**95.4%**					

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

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

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

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

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

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

Table 26. Blank analysis results for gross alpha and beta in (TSP) air filters, fourth quarter, 2021.

Collection Period		Corrected volume (m^3)[1]	Gross alpha			Gross beta		
Start	Stop		Value	± 2 SD	MDC	Value	±2 SD	MDC
4-inch filters								
09/29/21	10/06/21	2008	0.0	0.2	0.3	0.3	0.5	0.8
10/06/21	10/13/21	2008	0.0	0.1	0.3	0.3	0.5	0.8
10/13/21	10/20/21	2008	0.0	0.1	0.2	-0.2	0.5	0.8
10/20/21	10/27/21	2008	0.0	0.1	0.3	0.0	0.5	0.8
10/27/21	11/03/21	2008	0.1	0.1	0.2	-0.2	0.5	0.8
11/03/21	11/10/21	2008	0.0	0.1	0.3	-0.1	0.5	0.8
11/10/21	11/17/21	2008	0.1	0.1	0.2	0.5	0.5	0.8
11/17/21	11/24/21	2008	0.0	0.1	0.3	-0.2	0.5	0.9
11/24/21	12/01/21	2008	-0.1	0.1	0.3	-1.6	0.4	0.9
12/01/21	12/08/21	2008	-0.1	0.1	0.3	-0.1	0.5	0.8
12/08/21	12/15/21	2008	0.2	0.2	0.2	0.5	0.5	0.8
12/08/21	12/15/21	1296[2]	0.0	0.2	0.5	0.2	0.6	1.4
12/15/21	12/22/21	1296[2]	0.0	0.2	0.5	2.5	0.6	1.2
12/22/21	12/29/21	2008	0.1	0.2	0.3	0.2	0.5	0.8
12/22/21	12/29/21	1296[2]	-0.1	0.2	0.5	0.6	0.6	1.3
47-mm filters								
09/29/21	10/06/21	517	-0.3	0.4	0.8	-0.7	0.7	1.3
10/06/21	10/13/21	517	-0.7	0.4	0.9	-0.2	0.8	1.3
10/13/21	10/20/21	517	-0.1	0.3	0.6	-0.3	0.7	1.2
10/20/21	10/27/21	517	-0.2	0.4	0.8	-0.6	0.7	1.2
10/27/21	11/03/21	517	-0.4	0.4	0.8	-0.1	0.7	1.2
11/03/21	11/10/21	517	-0.3	0.3	0.6	0.2	0.6	1.0
11/10/21	11/17/21	517	-0.1	0.3	0.6	0.0	0.6	1.1
11/17/21	11/24/21	517	0.0	0.3	0.6	0.3	0.6	1.0
11/24/21	12/01/21	517	0.2	0.2	0.3	0.4	0.5	0.9
12/01/21	12/08/21	517	0.0	0.3	0.6	0.0	0.6	1.1
12/08/21	12/15/21	517	0.1	0.3	0.5	-0.1	0.6	1.1
12/15/21	12/22/21	517	0.4	0.3	0.3	-0.1	0.6	1.1
12/22/21	12/29/21	517	0.2	0.3	0.5	-0.2	0.6	1.1

Note: Concentration values, 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.
[2]Four inch punch from 8x10" filter.

Table 27. Blank analysis results for gamma spectroscopy for TSP air filters, composite samples, fourth quarter, 2021.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/13/22	**-8**	**26**	**45**	**70**	**76**	**124**	**0**	**9**	**16**
01/25/22	-31	92	160	-128	188	335	-1	7	12
Analysis Date	**Cesium-134**			**Cesium-137**		
	Concentration[1]	**± 2 SD**	**MDC**	**Concentration**	**± 2 SD**	**MDC**
01/13/22	**-1**	**3**	**6**	**-1**	**4**	**6**
01/25/22	-6	7	12	-2	8	13

Note: Results in **bold** are for 4-inch filters. Other results are for 47-mm filters. 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, fourth quarter, 2021.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP214ZTR01	10/29/2021	11/02/2021	11/25/2021	0.03	0.09	0.15
OP214ZTR02	10/29/2021	11/02/2021	11/25/2021	0.00	0.09	0.15
OP214ZTR03	12/28/2021	01/07/2022	01/13/2022	0.05	0.09	0.15
OP214ZTR04	12/28/2021	01/07/2022	01/13/2022	-0.03	0.09	0.15
OP214 Fridge	09/29/2021	12/29/2021	01/13/2022	0.00	0.09	0.15
OP214 Sink	09/29/2021	12/29/2021	01/13/2022	0.00	0.09	0.15

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, fourth quarter, 2021.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
211W761	10/12/2021	Field	0.0	0.2	0.4	Yes
211W767	10/21/2021	Field	0.0	0.2	0.4	Yes
Gross Beta						
211W761	10/12/2021	Field	-0.9	0.6	1.1	Yes
211W767	10/21/2021	Field	1.9	0.7	1.0	No
Cesium-137						
211W761	10/12/2021	Field	0.6	1.6	2.7	Yes
211W767	10/21/2021	Field	0.1	1.1	2.0	Yes
Tritium (Standard Method)						
211W762	10/12/2021	Field	20	90	150	Yes
211W768	10/21/2021	Field	60	90	150	Yes

MDC = minimum detectable concentration.

Table 30. Blank analysis results (µg/L) for metals in groundwater and/or surface water, fourth quarter, 2021.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
211W764	10/12/2921	Field	<2.0	<1.0	<1.0	<0.01	<1.0	3.2	<2.0	-
211W770	10/21/2021	Field	-	-	<1.0	-	-	-	-	-

Table 31. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, fourth quarter, 2021.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity†	NO_3+NO_2*	Total Phosphorus
211W763, 764, 765	10/12/2021	Field	<0.10	<0.10	<0.10	<0.10	-	<0.40	<0.80	<1.0	<0.01	<0.005
211W769, 771	10/20/2021	Field	-	-	-	-	-	<0.40	<0.80	<1.0	<0.01	-

† As $CaCO_3$.

* As N.

Table 32. Blank analysis results (µg/L) for VOCs in water, fourth quarter, 2021.

Sample Number	Sample Date	Blank Type	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	1,1-DCA	Carbon Tetrachloride	Methylene Chloride	Chloroform	Chloro-methane	Styrene
211W760	10/19/2021	Trip	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

RPD = relative percent difference

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

Table 33. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, fourth quarter, 2021.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	RPD	$\lvert R_1-R_2 \rvert$	$3(S_1^2+S_2^2)^{1/2}$	Within Criteria?
Gross Alpha										
PW-11	211W592	2.4	1.1	211W597	3.5	1.2	-37	1.1	2.4	Yes
USGS-115	211W659	1.7	0.8	211W667	1.5	0.9	13	0.2	1.8	Yes
TAN-2312	211W749	1.8	0.9	211W772	1.3	0.9	32	0.5	1.9	Yes
Shoshone Water Supply	211W803	1.1	0.9	211W808	0.5	0.8	75	0.6	1.8	Yes
Gross Beta										
PW-11	211W592	6.4	1.1	211W597	5.3	1.1	19	1.1	2.3	Yes
USGS-115	211W659	7.6	1.0	211W667	8.5	1.1	-11	0.9	2.2	Yes
TAN-2312	211W749	3.3	0.9	211W772	3.1	0.9	6	0.2	1.9	Yes
Shoshone Water Supply	211W803	3.4	1.0	211W808	3.9	0.9	-14	0.5	2.0	Yes
Cesium-137										
PW-11	211W592	0.5	1.4	211W597	0.4	1.3	22	0.1	2.9	Yes
USGS-115	211W659	-0.4	1.3	211W667	-0.3	1.5	29	0.1	3.0	Yes
TAN-2312	211W749	-1.0	1.3	211W772	0.4	1.3	467	1.4	2.8	Yes
Shoshone Water Supply	211W803	0.6	1.4	211W808	-0.2	1.4	400	0.8	3.0	Yes
Tritium (standard method)										
PW-11	211W593	580	120	211W598	610	120	-5	30	254	Yes
USGS-115	211W662	780	130	211W670	770	120	1	10	265	Yes
TAN-2312	211W750	0	90	211W773	-20	90	200	20	191	Yes
Shoshone Water Supply	211W804	-10	90	211W809	60	90	-280	70	191	Yes
Tritium (low-level method)										
MV-64	211W573	-3	7	211W578	-6	7	-67	3	15	Yes
TAN-2312	211W750	-4	6	211W773	0	7	200	4	14	Yes
Shoshone Water Supply	211W804	12	8	211W809	5	7	82	7	16	Yes
Strontium-90										
USGS-115	211W660	0.21	0.13	211W668	0.19	0.13	10	0.02	2.8	Yes
U-234										
USGS-115	211W663	0.59	0.15	211W671	0.67	0.17	-13	0.08	0.34	Yes
U-235										
USGS-115	211W663	0.08	0.051	211W671	0.003	0.03	186	0.077	0.089	Yes
U-238										
USGS-115	211W663	0.35	0.11	211W671	0.35	0.11	0	0	0.23	Yes
Technetium-99										
USGS-115	211W661	7.9	4.9	211W669	7.5	4.7	5	0.4	10.2	Yes

Table 34. Duplicate results for metals (µg/L) in groundwater, fourth quarter, 2021.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
PW-11	211W595	10/06/2021	-	-	15	-	-	-	-	-
PW-11	211W600	10/06/2021	-	-	15	-	-	-	-	-
RPD			**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**
USGS-115	211W665	10/04/2021	-	-	13	-	-	-	-	-
USGS-115	211W673	10/04/2021	-	-	13	-	-	-	-	-
RPD			**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**
TAN-2312	211W752	10/19/2021	-	-	7.0	-	-	-	-	-
TAN-2312	211W775	10/19/2021	-	-	7.0	-	-	-	-	-
RPD			**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**
Shoshone Water Supply	211W806	11/08/2021	-	-	2.2	-	-	-	-	-
Shoshone Water Supply	211W811	11/08/2021	-	-	2.4					
RPD			**-**	**-**	**-9**	**-**	**-**	**-**	**-**	**-**

RPD = relative percent difference.

Table 35. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, fourth quarter, 2021.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
PW-11	211W594, 596	10/06/2021	-	-	-	-	-	17.4	144	156	1.5	-
PW-11	211W599, 601	10/06/2021	-	-	-	-	-	17.1	134	158	1.5	-
RPD							**-**	**2**	**7**	**-1**	**0**	
USGS-115	211W664, 666	10/04/2021	-	-	-	-	-	44.0	24.9	110	1.5	-
USGS-115	211W672, 674	10/04/2021	-	-	-	-	-	44.4	25.2	109	1.5	-
RPD								**-1**	**-1**	**1**	**0**	
TAN-2312	211W751, 753	10/19/2021	-	-	-	-	-	8.58	25.2	125	0.75	-
TAN-2312	211W774, 776	10/19/2021	-	-	-	-	-	8.61	25.2	124	0.74	-
RPD								**-0.3**	**0**	**1**	**1**	
Shoshone Water Supply	211W805, 806, 807	11/08/2021	40	14	14	2.9	-	6.19	17.2	163	1.3	-
Shoshone Water Supply	211W810, 811, 812	11/08/2021	40	14	14	2.8	-	6.18	17.2	166	1.3	-
RPD			**0**	**0**	**0**	**4**		**0.2**	**0**	**-2**	**0**	

RPD = relative percent difference.

† As $CaCO_3$.

Table 36. Duplicate sample results (µg/L) for VOCs in water, fourth quarter, 2021.

Location	Sample Number	Sample Date	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	1,1-DCA	Carbon Tetrachloride	Methylene Chloride	Chloro-methane	Styrene	Chloro-form
TAN-2312	211W754	10/19/2021	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TAN-2312	211W777	10/19/2021	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

RPD = relative percent difference
Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane.

Table 37. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2021.

Sample Location	Sample Date	Original Result K-40 (pCi/g)[1]	Duplicate Result K-40 (pCi/g)[1]	K-40 RPD (%)	K-40 Less than 3 sigma test	K-40 Meets either criterion?	Original Result Cs-137 (pCi/g)[1]	Duplicate Result Cs-137 (pCi/g)[1]	Cs-137 RPD (%)	Cs-137 Less than 3 sigma test	Cs-137 Meets either criterion?
Roberts Met Tower	11/29/2021	18.2 ± 0.8	19.0 ± 0.9	-4.3	Yes	Yes	0.275 ± 0.066	0.342 ± 0.096	-21.7	Yes	Yes
Large Grid 6-3	12/02/2021	18.6 ± 0.8	19.1 ± 0.8	-2.6	Yes	Yes	0.668 ± 0.104	0.525 ± 0.103	24.0	Yes	Yes
Large Grid 24-8	12/03/2021	16.0 ± 0.7	16.0 ± 0.7	0.0	Yes	Yes	0.478 ± 0.081	0.511 ± 0.086	-6.7	Yes	Yes
Sand Dunes Air Station	12/08/2021	16.7 ± 0.8	17.2 ± 0.9	-3.0	Yes	Yes	0.287 ± 0.065	0.284 ± 0.079	1.1	Yes	Yes
ESER Soil Site Atomic City	12/10/2021	16.6 ± 0.8	16.0 ± 0.9	3.7	Yes	Yes	0.510 ± 0.097	0.477 ± 0.100	6.7	Yes	Yes

[1]Result ±2 SD

Table 38. Spiked sample results (µg/L) for metals in water, fourth quarter, 2021.

Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W648	10/13/2021	59.8	59	99	28.5	30	105	<1.0	<1.0	100	7.51	8.6	115	-	-	-

Table 39. Spiked sample results (mg/L) for common ions and nutrients in water, fourth quarter, 2021.

Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W647, 648	10/13/2021	<0.10	<0.10	100	12.5	12	96	<0.10	<0.10	100	2.93	2.8	96	-	-	-

Table 39. (Continued) Spiked sample results (mg/L) for common ions and nutrients in water, fourth quarter, 2021.

Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity			$NO_3 + NO_2$*			Total Phosphorus		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W647,649	10/13/2021	53.3	55.2	104	28.9	29.6	102	50.9	49.5	97	1.26	1.2	95	-	-	-

*As N.

Table 40. Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2021.

Sample Number	Sample Date	Carbon Tetrachloride			Styrene			Tetrachloroethene			Trichloroethene			Vinyl Chloride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W650	10/13/2021	11.7	12.7	109	8.38	9.25	110	12.7	12.5	98	17.0	17.9	105	14.4	16.2	112

Table 40 (continued). Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2021.

Sample Number	Sample Date	1,2-Dichloroethane			1,1-Dichloroethene			Cis-1,2-Dichloroethene			Trans-1,2-Dichloroethene			Methylene Chloride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W650	10/13/2021	12.3	12.4	101	17.2	20.4	119	10.2	10.1	99	4.82	5.33	111	9.82	11.7	119

Table 40 (continued). Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2021.

Sample Number	Sample Date	Benzene			Chlorobenzene			1,2-Dichlorobenzene			1,4-Dichlorobenzene			1,2-Dichloropropane		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W650	10/13/2021	7.39	8.03	109	15.1	15.9	105	16.5	19.2	116	7.02	7.33	104	7.82	8.03	103

Table 40 (continued). Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2021.

Sample Number	Sample Date	Ethylbenzene			Toluene			1,2,4-Trichlorobenzene			1,1,1-Trichloroethane			1,1,2-Trichloroethane		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
211W650	10/13/2021	4.86	4.95	102	18.0	18.1	101	11.8	12.9	109	7.01	7.78	111	6.53	6.62	101

Table 41. Electret ionization chamber (EIC) irradiation results (EIC reader SPER-1E, S/N E0988), fourth quarter, 2021.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SMD399	40.0	2.0	38.9	1.4	97.3%	Yes
SMD597	40.0	2.0	38.4	1.4	95.9%	Yes
SMD541	40.0	2.0	38.9	1.4	97.3%	Yes
				Triplicate AVG:	**96.8%**	**Yes**
SMDG630	30.0	1.5	28.8	1.4	96.1%	Yes
SMDG524	30.0	1.5	27.0	1.4	90.2%	Yes
SMD428	30.0	1.5	29.5	1.4	98.3%	Yes
				Triplicate AVG:	**94.9%**	**Yes**
SKR313	20.0	1.0	19.1	1.3	95.7%	Yes
SKR500	20.0	1.0	19.9	1.4	99.6%	Yes
SKR435	20.0	1.0	18.8	1.4	94.2%	Yes
				Triplicate AVG:	**96.5%**	**Yes**

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.
[1] Net measured exposure estimate includes a correction for atmospheric pressure. EIC reader was SPER-1E, **SN E0988**.

Table 42. Electret ionization chamber (EIC) irradiation results (EIC reader SPER-1E, S/N E1365), fourth quarter, 2021.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SMD399	40.0	2.0	38.3	1.4	95.9%	Yes
SMD597	40.0	2.0	37.2	1.4	92.9%	Yes
SMD541	40.0	2.0	40.1	1.4	100.2%	Yes
				Triplicate AVG:	**96.3%**	**Yes**
SMDG630	30.0	1.5	29.4	1.4	98.1%	Yes
SMDG524	30.0	1.5	28.2	1.4	94.1%	Yes
SMD428	30.0	1.5	26.6	1.4	88.5%	Yes
				Triplicate AVG:	**93.6%**	**Yes**
SKR313	20.0	1.0	19.1	1.3	95.7%	Yes
SKR500	20.0	1.0	19.3	1.4	96.6%	Yes
SKR435	20.0	1.0	18.8	1.4	94.2%	Yes
				Triplicate AVG:	**95.5%**	**Yes**

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.
[1] Net measured exposure estimate includes a correction for atmospheric pressure. EIC reader was SPER-1E, **SN E1365**.

Table 43. Air sampling field equipment service reliability (percent operational), fourth quarter, 2021.

Station Locations	Sample Type			
	TSP[3]	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%,** 85%	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	**69%,** 100%	100%	100%	NC[1]
Idaho Falls	**100%,** 100%	100%	100%	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] **Bold** values are for 4-inch TSP samplers, others are for 47-mm TSP samplers.

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 4-inch TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	09/29/21	10/06/21	1.1	0.4	43.3	1.9
	10/06/21	10/13/21	0.8	0.3	23.5	1.5
	10/13/21	10/20/211	1.1	0.3	38.3	1.4
	10/20/21	10/27/211	0.9	0.3	25.3	1.2
	10/27/21	11/03/21	0.8	0.2	27.8	1.2
	11/03/21	11/10/212	0.5	0.2	20.5	1.0
	11/10/21	11/17/212	0.4	0.2	23.2	1.1
	11/17/21	11/24/212	0.1	0.2	21.5	1.1
	11/24/21	12/01/212	0.7	0.2	34.9	1.2
	12/01/21	12/08/212	0.8	0.2	35.3	1.3
	12/08/21	12/15/212	0.2	0.2	15.5	0.9
	12/15/21	12/22/212	0.3	0.2	23.9 J+	1.0 J+
	12/22/21	12/29/212	0.3	0.2	14.1	0.9
Experimental Field Station	09/29/21	10/06/21[1]	1.4	0.5	31.1	1.9
	10/06/21	10/13/21[1]	0.7	0.4	21.2	1.6
	10/13/21	10/20/21[1]	1.1	0.3	30.0	1.3
	10/20/21	10/27/21[1]	0.6	0.2	21.4	1.0
	10/27/21	11/03/21	0.6	0.2	19.8	0.8
	11/03/21	11/10/21	0.4	0.2	18.9	0.9
	11/10/21	11/17/21[1]	0.9	0.2	30.6	1.3
	11/17/21	11/24/21[1]	0.7	0.3	24.4	1.3
	11/24/21	12/01/21[1]	1.1	0.3	35.8	1.3
	12/01/21	12/08/21[1]	1.1	0.3	39.5	1.4
	12/08/21	12/15/21[1]	0.4	0.2	21.5	1.2
	12/15/21	12/22/21[1]	0.8	0.3	43.0 J+	1.6 J+
	12/22/21	12/29/21[1]	0.4	0.2	14.4	1.0
Sand Dunes Tower	09/29/21	10/06/21[1]	0.9	0.5	45.2	2.3
	10/06/21	10/13/21	0.7	0.3	23.2	1.5
	10/13/21	10/20/21[1]	0.9	0.3	35.5	1.4
	10/20/21	10/27/21	0.6	0.2	24.6	1.1
	10/27/21	11/03/21	0.9	0.2	31.6	1.2
	11/03/21	11/10/21	1.1	0.3	33.6	1.3
	11/10/21	11/17/21	0.7	0.2	36.5	1.3
	11/17/21	11/24/21	0.8	0.2	36.3	1.3
	11/24/21	12/02/21[2]	1.1	0.2	43.2	1.2
	12/02/21	12/08/21[3]	1.0	0.3	48.2	1.6
	12/08/21	12/15/21[2]	0.2	0.2	19.0	1.0
	12/15/21	12/22/21[2]	0.3	0.2	37.9 J+	1.2 J+
	12/22/21	12/29/21[2]	0.4	0.2	19.8	1.0

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 4-inch TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	09/29/21	10/06/21	1.2	0.5	53.3	2.5
	10/06/21	10/13/21	1.2	0.4	25.1	1.7
	10/13/21	10/15/21[4]	0.7	0.9	22.5	4.0
	10/15/21	10/20/21[3]	0.9	0.3	28.7	1.5
	10/20/21	10/27/21[2]	0.3	0.2	20.5	1.0
	10/27/21	11/03/21[2]	0.4	0.2	23.6	1.1
	11/03/21	11/10/21[2]	0.6	0.2	24.1	1.1
	11/10/21	11/17/21[2]	0.5	0.2	24.6	1.1
	11/17/21	11/24/21[2]	0.4	0.2	23.5	1.1
	11/24/21	12/01/21[2]	0.7	0.2	38.6	1.4
	12/01/21	12/08/21[2]	0.7	0.2	39.2	1.4
	12/08/21	12/15/21[2]	0.3	0.2	18.1	1.0
	12/15/21	12/22/21[2]	0.3	0.2	29.3 J+	1.1 J+
	12/22/21	12/29/21[2]	0.1	0.2	15.2	0.9
Boundary Locations						
Atomic City	09/29/21	10/06/21[1]	1.5	0.5	47.1	2.4
	10/06/21	10/13/21	0.8	0.3	20.9	1.6
	10/13/21	10/20/21[1]	1.1	0.3	35.8	1.4
	10/20/21	10/27/21	0.6	0.2	25.7	1.3
	10/27/21	11/03/21	1.0	0.2	27.8	1.2
	11/03/21	11/10/21	0.9	0.2	30.2	1.2
	11/10/21	11/17/21[1]	0.8	0.2	38.1	1.4
	11/17/21	11/24/21	0.7	0.3	29.6	1.2
	11/24/21	12/01/21[1]	1.9	0.3	51.8	1.6
	12/01/21	12/08/21	1.2	0.3	53.3	1.5
	12/08/21	12/15/21	0.6	0.2	20.4	1.0
	12/15/21	12/22/21[2]	0.4	0.2	30.9 J+	1.0 J+
	12/22/21	12/29/21[2]	0.2	0.2	17.8	1.0
Howe	09/29/21	10/06/21	1.4	0.4	45.2	1.9
	10/06/21	10/13/21[1]	0.7	0.3	23.9	1.4
	10/13/21	10/20/21[1]	1.0	0.3	33.0	1.3
	10/20/21	10/27/21[1]	0.7	0.2	25.8	1.1
	10/27/21	11/03/21[1]	0.9	0.2	34.0	1.3
	11/03/21	11/10/21[1]	1.0	0.3	32.6	1.3
	11/10/21	11/17/21	1.0	0.3	37.5	1.4
	11/17/21	11/24/21[1]	1.0	0.3	35.0	1.4
	11/24/21	12/01/21[1]	2.0	0.3	48.1	1.5
	12/01/21	12/08/21[1]	1.4	0.3	62.1	1.7
	12/08/21	12/15/21	0.9	0.3	27.1	1.3
	12/15/21	12/22/21[1]	0.9	0.3	44.0 J+	1.5 J+
	12/22/21	12/29/21[5]	0.6	0.4	27.1	1.7

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	09/29/21	10/06/21[1]	1.1	0.4	38.8	1.8
	10/06/21	10/13/21[1]	0.7	0.3	24.8	1.5
	10/13/21	10/20/21[1]	1.3	0.3	36.2	1.4
	10/20/21	10/27/21	0.8	0.2	23.1	1.1
	10/27/21	11/03/21	0.8	0.2	26.8	1.1
	11/03/21	11/10/21	0.7	0.2	28.9	1.2
	11/10/21	11/17/21	0.9	0.2	33.5	1.2
	11/17/21	11/24/21	0.8	0.2	27.8	1.2
	11/24/21	12/02/21[2]	0.8	0.2	34.2	1.1
	12/02/21	12/08/21[3]	1.0	0.3	52.8	1.6
	12/08/21	12/15/21[2]	0.3	0.2	22.5	1.1
	12/15/21	12/22/21[2]	0.2	0.2	30.1 J+	1.1 J+
	12/22/21	12/29/21[2]	0.2	0.2	19.2	1.0
Mud Lake	09/29/21	10/06/21[1]	1.5	0.3	43.1	1.6
	10/06/21	10/13/21[1]	0.7	0.3	24.1	1.3
	10/13/21	10/20/21[1]	1.0	0.3	35.8	1.4
	10/20/21	10/27/21[1]	0.8	0.3	26.0	1.3
	10/27/21	11/03/21[1]	0.9	0.3	32.3	1.4
	11/03/21	11/10/21	0.8	0.2	28.9	1.2
	11/10/21	11/17/21[1]	1.3	0.3	41.8	1.5
	11/17/21	11/24/21[1]	1.1	0.3	38.0	1.5
	11/24/21	12/01/21[1]	1.8	0.3	58.1	1.7
	12/01/21	12/08/21[1]	1.3	0.3	58.2	1.7
	12/08/21	12/15/21[1]	0.8	0.3	31.1	1.4
	12/15/21	12/22/21[1]	0.8	0.3	50.8 J+	1.8 J+
	12/22/21	12/29/21[1]	0.9	0.3	28.4	1.3
Distant Locations						
Craters of the Moon	09/29/21	10/06/21	NS[6]	NS	NS	NS
	10/06/21	10/13/21	NS[6]	NS	NS	NS
	10/14/21	10/20/21	0.3	0.2	23.2	1.2
	10/20/21	10/27/21	NS[6]	NS	NS	NS
	10/27/21	11/03/21	NS[6]	NS	NS	NS
	11/03/21	11/10/21[2]	0.4	0.2	20.2	1.0
	11/10/21	11/17/21[2]	0.3	0.2	20.9	1.0
	11/17/21	11/24/21[2]	0.2	0.2	18.7	1.0
	11/24/21	12/01/21[2]	0.5	0.2	29.2	1.1
	12/01/21	12/08/21[2]	0.7	0.2	35.8	1.3
	12/08/21	12/15/21[2]	0.4	0.2	16.6	1.0
	12/15/21	12/22/21[2]	0.4	0.2	24.7 J+	1.1 J+
	12/22/21	12/29/21[2]	0.2	0.2	12.0	0.8

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 4-inch TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	09/29/21	10/06/21	NS[6]	NS	NS	NS
	10/06/21	10/13/21	NS[6]	NS	NS	NS
	10/13/21	10/20/21	NS[6]	NS	NS	NS
	10/20/21	10/27/21	NS[6]	NS	NS	NS
	10/27/21	11/03/21	NS[6]	NS	NS	NS
	11/03/21	11/10/21	NS[6]	NS	NS	NS
	11/10/21	11/17/21	NS[6]	NS	NS	NS
	11/17/21	11/24/21	NS[6]	NS	NS	NS
	11/24/21	12/01/21	NS[6]	NS	NS	NS
	12/01/21	12/08/21	NS[6]	NS	NS	NS
	12/08/21	12/15/21	NS[6]	NS	NS	NS
	12/15/21	12/22/21	NS[6]	NS	NS	NS
	12/22/21	12/29/21	NS[6]	NS	NS	NS
Idaho Falls	09/29/21	10/06/21[1]	1.3	0.4	33.2	1.6
	10/06/21	10/13/21[1]	0.6	0.3	20.2	1.4
	10/13/21	10/20/21[1]	0.9	0.2	30.0	1.3
	10/20/21	10/27/21[1]	0.6	0.2	24.5	1.1
	10/27/21	11/03/21[1]	0.8	0.2	23.6	1.1
	11/03/21	11/10/21[1]	0.7	0.2	26.5	1.2
	11/10/21	11/17/21[1]	1.1	0.2	36.4	1.3
	11/17/21	11/24/21[1]	0.6	0.2	26.5	1.2
	11/24/21	12/01/21[1]	1.1	0.3	43.3	1.4
	12/01/21	12/08/21[1]	1.1	0.3	47.5	1.5
	12/08/21	12/15/21[1]	0.7	0.2	25.3	1.2
	12/15/21	12/22/21[3]	0.5	0.2	30.3 J+	1.1 J+
	12/22/21	12/29/21[2]	0.3	0.2	17.2	1.0
Idaho Falls[DP]	09/29/21	10/06/21[2]	0.9	0.5	31.4	1.9
	10/06/21	10/13/21[2]	0.6	0.4	13.3	1.5
	10/13/21	10/20/21[2]	0.6	0.2	21.0	1.2
	10/20/21	10/27/21[2]	0.4	0.2	19.7	1.0
	10/27/21	11/03/21[2]	0.6	0.2	19.6	1.0
	11/03/21	11/10/21[2]	0.4	0.2	20.5	1.0
	11/10/21	11/17/21[2]	0.3	0.2	21.0	1.0
	11/17/21	11/24/21[2]	0.3	0.2	20.6	1.1
	11/24/21	12/01/21[2]	0.7	0.2	37.9	1.2
	12/01/21	12/08/21[2]	1.3	0.3	41.4	1.3
	12/08/21	12/15/21[7]	0.4	0.2	18.5	1.0
	12/15/21	12/22/21	NS[6]	NS	NS	NS
	12/22/21	12/29/21	NS[6]	NS	NS	NS

Note: MDCs typically range from (0.2 to 0.7) x 10^{-3} pCi/m^3 for gross alpha and from (0.7 to 1.8) x 10^{-3} pCi/m^3 for gross beta.
[1] Estimated volume. Results are considered (usable) estimates.
[2] Four inch diameter punch from 8x10 inch filter.
[3] Four inch diameter punch from 8x10 inch filter. Partial sample.
[4]Sampler changed on 10/15/21 from 4-inch filter to 8x10 inch filter.
[5]Partial sample. Motor was off upon arrival. Estimated volume. Results are considered (usable) estimates.
[6]No sample.
[7]Four inch diameter punch from 8x10 inch filter. Estimated volume. Results are considered (usable) estimates.
[8]Operated by Shoshone-Bannock Tribes.

Table A-2. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 47-mm TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	09/29/21	10/06/21[1]	1.7	0.6	29.0	1.6
	10/06/21	10/13/21[1]	0.1	0.5	16.3	1.3
	10/13/21	10/20/21[1]	0.8	0.4	24.7	1.5
	10/20/21	10/27/21[1]	0.3	0.5	15.4	1.3
	10/27/21	11/03/21	-0.1	0.5	26.2	1.7
	11/03/21	11/10/21	0.5	0.5	26.0	1.8
	11/10/21	11/17/21	1.1	0.6	28.2	1.9
	11/17/21	11/24/21	0.7	0.5	26.4	1.8
	11/24/21	12/01/21	0.9	0.4	37.8	1.9
	12/01/21	12/08/21	0.9	0.5	62.5	2.5
	12/08/21	12/15/21	1.0	0.5	15.8	1.4
	12/15/21	12/22/21	0.6 J+	0.3 J+	29.2	1.9
	12/22/21	12/29/21	0.6	0.5	16.1	1.5
Experimental Field Station	09/29/21	10/06/21[1]	1.9	0.6	31.7	1.7
	10/06/21	10/13/21[1]	0.2	0.5	17.9	1.3
	10/13/21	10/20/21[1]	1.1	0.4	25.4	1.5
	10/20/21	10/27/21[1]	0.4	0.5	21.4	1.5
	10/27/21	11/03/21	-0.1	0.4	24.2	1.5
	11/03/21	11/10/21	0.4	0.4	23.7	1.4
	11/10/21	11/17/21	0.8	0.4	29.7	1.5
	11/17/21	11/24/21	1.2	0.4	25.0	1.4
	11/24/21	12/01/21	1.2	0.4	45.9	1.8
	12/01/21	12/08/21	1.2	0.4	38.0	1.7
	12/08/21	12/15/21	0.6	0.3	17.4	1.2
	12/15/21	12/22/21	0.8 J+	0.3 J+	33.9	1.6
	12/22/21	12/29/21	0.3	0.3	19.6	1.4
Sand Dunes Tower	09/29/21	10/06/21[1]	2.1	0.6	29.9	1.7
	10/06/21	10/13/21[1]	0.2	0.5	16.4	1.3
	10/13/21	10/20/21[1]	0.9	0.4	25.6	1.4
	10/20/21	10/27/21[1]	0.4	0.4	17.4	1.3
	10/27/21	11/03/21	-0.3	0.3	23.0	1.4
	11/03/21	11/10/21	0.5	0.4	24.3	1.3
	11/10/21	11/17/21	0.6	0.4	29.0	1.4
	11/17/21	11/24/21	0.9	0.4	28.4	1.4
	11/24/21	12/01/21	1.4	0.4	44.9	1.7
	12/01/21	12/08/21	0.7	0.4	45.9	1.8
	12/08/21	12/15/21	0.8	0.4	22.2	1.4
	12/15/21	12/22/21	0.8 J+	0.3 J+	37.0	1.7
	12/22/21	12/29/21	0.6	0.4	19.1	1.3

Table A-2 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 47-mm TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	09/29/21	10/06/21[1]	1.5	0.6	28.4	1.6
	10/06/21	10/13/21[1]	0.1	0.5	13.9	1.2
	10/13/21	10/20/21[2]	1.4	0.6	35.4	2.1
	10/20/21	10/27/21[1]	0.5	0.4	15.9	1.3
	10/27/21	11/03/21	0.0	0.4	24.4	1.4
	11/03/21	11/10/21	1.0	0.5	35.7	1.8
	11/10/21	11/17/21	1.0	0.4	27.3	1.4
	11/17/21	11/24/21	0.4	0.3	26.4	1.4
	11/24/21	12/01/21[3]	1.9	0.7	82.7	3.7
	12/01/21	12/08/21[3]	0.8	0.4	42.3	1.8
	12/08/21	12/15/21[4]	0.3	0.3	15.9	1.1
	12/15/21	12/22/21	0.6 J+	0.3 J+	27.1	1.4
	12/22/21	12/29/21	0.2	0.3	15.5	1.1
Boundary Locations						
Atomic City	09/29/21	10/06/21[1]	2.4	0.6	31.9	1.7
	10/06/21	10/13/21[1]	0.3	0.5	17.0	1.3
	10/13/21	10/20/21[1]	1.0	0.4	24.8	1.5
	10/20/21	10/27/21[1]	0.9	0.5	21.5	1.5
	10/27/21	11/03/21	0.5	0.4	20.3	1.3
	11/03/21	11/10/21[3]	1.0	0.8	40.0	2.8
	11/10/21	11/17/21	NS	NS	NS	NS
	11/17/21	11/24/21	NS	NS	NS	NS
	11/26/21	12/01/21[5]	3.1	1.1	35.2	3.3
	12/01/21	12/08/21[6]	2.2	0.9	67.7	3.4
	12/08/21	12/15/21	1.1	0.4	19.8	1.2
	12/15/21	12/22/21	0.4 J+	0.2 J+	21.1	1.3
	12/22/21	12/29/21	0.1	0.3	16.7	1.1
Howe	09/29/21	10/06/21[1]	1.1	0.6	23.5	1.6
	10/06/21	10/13/21[1]	0.2	0.5	12.0	1.2
	10/13/21	10/20/21[1]	0.7	0.4	17.7	1.4
	10/20/21	10/27/21[1]	0.1	0.5	17.9	1.5
	10/27/21	11/03/21	0.3	0.5	29.9	1.7
	11/03/21	11/10/21	0.8	0.4	26.4	1.4
	11/10/21	11/17/21	0.7	0.4	26.0	1.5
	11/17/21	11/24/21	0.9	0.5	39.1	2.1
	11/24/21	12/01/21	1.7	0.5	58.3	2.5
	12/01/21	12/08/21	1.3	0.6	70.6	2.8
	12/08/21	12/15/21	1.2	0.6	29.6	2.0
	12/15/21	12/22/21	1.1 J+	0.4 J+	47.0	2.3
	12/22/21	12/29/21[3]	1.4	1.0	33.1	3.0

Table A-2 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 47-mm TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	09/29/21	10/06/21[1]	2.7	0.6	29.1	1.4
	10/06/21	10/13/21[1]	0.5	0.4	15.5	1.1
	10/13/21	10/20/21[1]	0.9	0.4	24.9	1.3
	10/20/21	10/27/21[1]	0.2	0.3	16.0	1.1
	10/27/21	11/03/21	0.0	0.3	19.4	1.2
	11/03/21	11/10/21	0.5	0.3	23.5	1.3
	11/10/21	11/17/21	0.9	0.4	29.4	1.4
	11/17/21	11/24/21	0.8	0.4	28.0	1.4
	11/24/21	12/01/21	1.2	0.4	36.6	1.5
	12/01/21	12/08/21	1.0	0.4	46.6	1.8
	12/08/21	12/15/21	0.7	0.3	20.9	1.3
	12/15/21	12/22/21	1.0 J+	0.3 J+	27.3	1.4
	12/22/21	12/29/21	0.5	0.3	18.5	1.2
Mud Lake	09/29/21	10/06/21[1]	2.5	0.6	31.2	1.6
	10/06/21	10/13/21[1]	0.1	0.4	15.2	1.2
	10/13/21	10/20/21[1]	0.8	0.4	25.3	1.4
	10/20/21	10/27/21[1]	0.1	0.4	18.3	1.3
	10/27/21	11/03/21	0.4	0.4	20.5	1.3
	11/03/21	11/10/21	0.6	0.4	24.9	1.3
	11/10/21	11/17/21	1.3	0.4	29.8	1.5
	11/17/21	11/24/21	1.1	0.4	29.6	1.5
	11/24/21	12/01/21	1.3	0.4	42.2	1.7
	12/01/21	12/08/21	1.2	0.4	47.9	1.8
	12/08/21	12/15/21	0.6	0.3	20.0	1.2
	12/15/21	12/22/21	0.7 J+	0.3 J+	32.2	1.5
	12/22/21	12/29/21	0.5	0.3	18.0	1.2
Distant Locations						
Craters of the Moon	09/29/21	10/06/21[1]	1.7	0.7	36.8	1.9
	10/06/21	10/13/21[1]	-0.1	0.5	17.4	1.4
	10/13/21	10/20/21[1]	0.9	0.4	23.6	1.5
	10/20/21	10/27/21[1]	0.3	0.5	16.2	1.4
	10/27/21	11/03/21[7]	-0.3	0.5	21.5	1.6
	11/03/21	11/10/21	0.3	0.5	25.2	2.0
	11/10/21	11/17/21	0.8	0.5	22.0	1.6
	11/17/21	11/24/21	0.4	0.5	20.2	1.5
	11/24/21	12/01/21	1.0	0.4	28.2	1.7
	12/01/21	12/08/21	0.9	0.5	32.8	1.9
	12/08/21	12/15/21	0.5	0.4	15.2	1.4
	12/15/21	12/22/21	0.7 J+	0.4 J+	22.4	1.6
	12/22/21	12/29/21	0.6	0.5	12.5	1.3

Table A-2 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 47-mm TSP filters for all locations, fourth quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[8]	09/29/21	10/06/21[8]	1.2	0.5	18.5	1.3
	10/06/21	10/13/21[8]	-0.1	0.4	9.2	1.0
	10/13/21	10/20/21[8]	0.4	0.3	15.3	1.2
	10/20/21	10/27/21[8]	0.0	0.3	11.1	1.0
	10/27/21	11/03/21[8]	-0.1	0.3	12.6	1.1
	11/03/21	11/10/21[8]	0.3	0.3	13.5	1.0
	11/10/21	11/17/21[8]	0.7	0.3	17.1	1.1
	11/17/21	11/24/21[8]	0.5	0.3	13.5	1.0
	11/24/21	12/01/21[8]	1.0	0.3	22.2	1.2
	12/01/21	12/08/21[8]	0.8	0.4	24.8	1.3
	12/08/21	12/15/21[8]	0.5	0.3	11.0	1.0
	12/15/21	12/22/21[8]	0.8 J+	0.3 J+	17.7	1.2
	12/22/21	12/29/21[8]	0.6	0.3	10.0	1.0
Idaho Falls	09/29/21	10/06/21[3]	1.2	0.6	18.4	1.5
	10/06/21	10/13/21[1]	0.8	0.5	15.5	1.3
	10/13/21	10/20/21[1]	1.0	0.4	23.4	1.5
	10/20/21	10/27/21[1]	0.4	0.5	17.8	1.3
	10/27/21	11/03/21	0.6	0.5	20.8	1.4
	11/03/21	11/10/21	0.6	0.4	27.0	1.5
	11/10/21	11/17/21	1.7	0.5	38.2	1.8
	11/17/21	11/24/21	1.5	0.5	37.3	1.8
	11/24/21	12/01/21	2.4	0.6	68.7	2.5
	12/01/21	12/08/21	1.8	0.6	70.8	2.7
	12/08/21	12/15/21	1.1	0.5	32.8	1.9
	12/15/21	12/22/21	2.1 J+	0.6 J+	62.1	2.7
	12/22/21	12/29/21	1.0	0.6	38.1	2.3

Note: MDCs typically range from (0.3 to 1.0) x 10^{-3} pCi/m^3 for gross alpha and from (0.7 to 1.8) x 10^{-3} pCi/m^3 for gross beta.
[1]The sampling orientation was improper with the filter not fully exposed to ambient air. The data should be considered estimates. Filter was positioned correctly on 10/21/21.
[2]Partial Sample. The sampling orientation was improper with the filter not fully exposed to ambient air. The data should be considered estimates. Filter was positioned correctly on 10/21/21.
[3] Partial sample. Power was off upon arrival. Estimated volume. Results are considered estimates.
[4]Filter was accidentally damaged (torn).
[5]Partial sample. New pump deployed 11-26-21.
[6]Partial sample. Roughly 24 hours of dead time.
[7]Flow rate was changed mid-week. Volume is an estimate. Results are considered estimates.
[8]Operated by Shoshone-Bannock Tribes. The sampling orientation was improper with the filter not fully exposed to ambient air. Results are considered estimates.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, fourth quarter, 2021.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	11.7	3.2
Craters of the Moon	10.4	4.9
Big Lost River Rest Area	13.7	3.5
Van Buren Avenue	14.2	2.8
Experimental Field Station	13.9	1.9
Main Gate	12.9	5.0
Atomic City	13.0	5.3
Taber	11.0	0.8
Blackfoot	9.8	0.8
Ft. Hall	9.0	1.7
Idaho Falls	8.6	1.2
Mud Lake/ Terreton	12.4	1.2
Monteview	11.4	1.7
Sand Dunes	12.7	3.1
Howe Met. Tower	12.0	2.0
MP282 -20	12.0	1.5
MP280 -20	14.0	0.6
MP278 -20	17.4	5.0
MP276 -20	9.9, 11.0	-
MP274 -20	10.5	1.7
MP272 -20	11.9	1.6
MP270 -20	NS[2]	NS[2]
MP268 -20	12.3, 15.2	-
MP266 -20	11.3	1.4
MP264 -20	16.0	0.7
MP270 -20/26	15.8	0.9
MP268 -20/26	14.8	0.9
MP266 -20/26	11.7	2.7
MP263 -20/26	14.3	4.0
MP261 -20/26	12.8	4.7
MP259 -20/26	11.5	2.8
MP256 -20/26	10.6	2.4
MFC (EBR II)	14.0	2.3
EBR I	10.2	2.2
RWMC	11.4	3.7
CFA	14.3	2.0
CITRC (PBF)	14.7, 15.1	-
INTEC	16.5, 18.9	-
ATR (TRA)	11.1	0.3
NRF	10.8, 11.8	-
TAN/SMC	9.3	2.3
Mud Lake Bank of Commerce	16.4	3.6
MP43-33	14.1	4.2
MP41-33	10.9	3.9
MP39-33	13.4	1.5
MP37-33	10.7	4.8
MP35-33	10.9	1.6
MP33-33	14.0	2.0
MP31-33	8.3	1.3
MP29-33	13.1	0.6

Table B.1. continued. Results for all electret ionization chamber (EIC) locations, fourth quarter, 2021.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP27-33	10.2	1.9
MP25-33	11.8	3.3
MP23-33	12.9	2.6
MP21-33	12.5	4.3
MP19-33	11.8	3.4
MP14-33	10.9	5.2
MP11-33	10.0	5.2
MP06-33	12.6	3.7
MP03-33	11.0	1.5
Base of Howe	10.7	0.5
Rover	13.1	3.0
Hamer	15.2	3.5
Sugar City	15.2	4.2
Roberts	13.4	3.1
Big Southern Butte	12.5	2.2
T4 North	14.2	2.9
T4 South	11.4	0.9

[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. Electrets were missing upon arrival.

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
Trichloroethene (TCE)	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 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