

Department of Environmental Quality
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT**

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Table of Acronyms

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

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 first quarter, 2018 (**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 high-volume total suspended particulate (TSP) air samplers. Starting midway through the 3rd quarter 2016 another model HVP 4304 TSP sampler was started at Idaho Falls air station alongside the current sampler (HVP 3804). The new sampler (HVP 4304) is being operated to test dependability and durability under field conditions. Weekly gross alpha and gross beta particulate radioactivity results for filters from the TSP samplers are presented in **Appendix A** and summarized as a range of results in **Table 2**. Results are within the expected historical range.

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the first quarter of 2018 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

Annual composites of filters collected using TSP samplers are also analyzed using radiochemical separation techniques. Results from the annual composite analyses are typically presented in the following year's first quarter report. The samples are analyzed for Strontium-90, Plutonium-238, Plutonium-239/240, and Americium-241 (**Table 6**). Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons. DEQ-INL OP's action levels of 190 for Americium-241, 1900 for Strontium-90, 210 for Plutonium-238, and 200 for

Plutonium-239/240 (in 1×10^{-6} pCi/m³) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation. There are two results which exceed the ²³⁹Pu/²⁴⁰Pu MDC for the 2017 annual composite at the Atomic City and Montevue sampling sites. Though minimally exceeding the MDC, the results are well under the specified regulatory limits and DEQ-INL OP's action levels.

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. 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 first quarter.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. All results are below MDCs and below the DEQ-INL OP action level of 150 pCi/m³ (40 CFR 61). Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the first quarter of 2018. Precipitation samples were analyzed for tritium and gamma-emitting radionuclides. Reported values were either the result of a single sample or a weighted mean when more than one precipitation sample was collected during the calendar quarter. Tritium and gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the first quarter of 2018. Tritium and Cesium-137 analysis results are presented in **Table 5**.

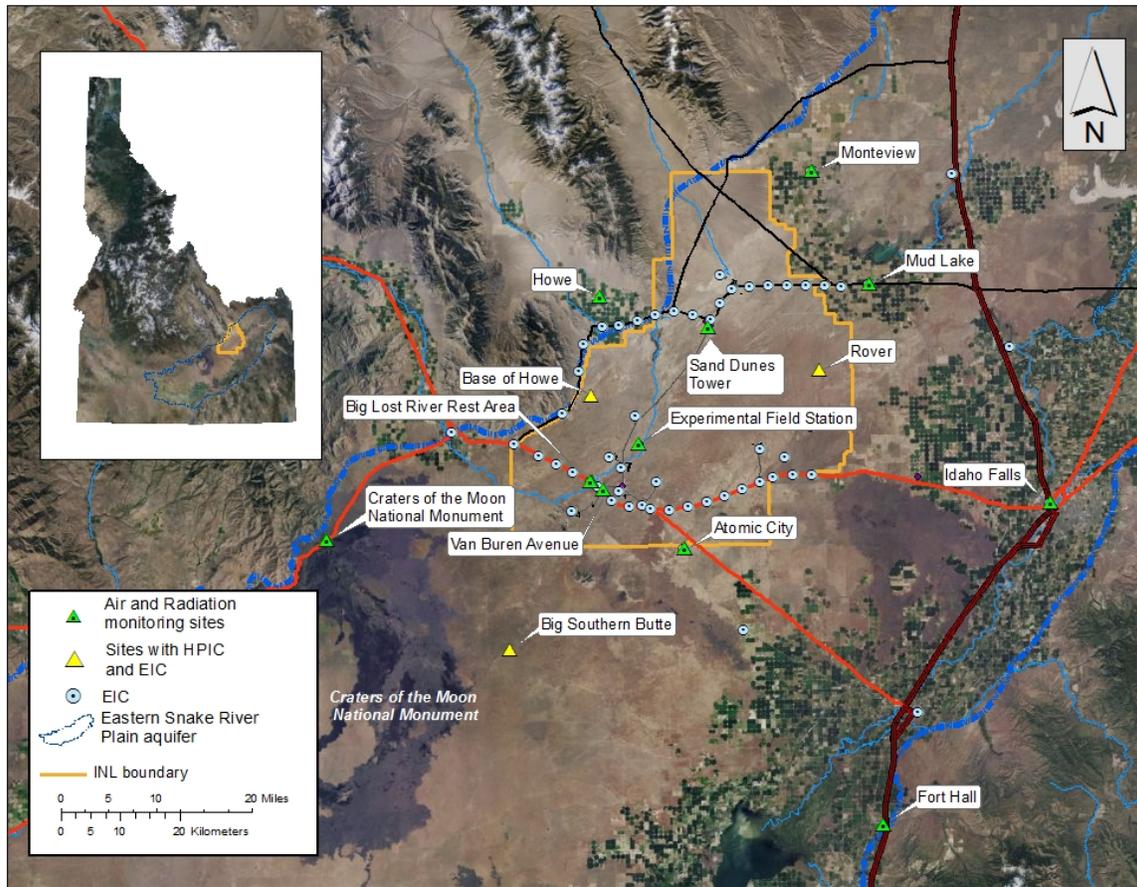


Figure 1. Air and radiation monitoring locations.

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	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Experimental Field Station	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sand Dunes Tower	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Van Buren Avenue	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Boundary Locations				
Atomic City	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Howe	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monteview	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mud Lake	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Distant Locations				
Craters of the Moon	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fort Hall ²	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Idaho Falls	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

¹ Samples collected weekly; Samples collected quarterly.

²TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2018.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.3	-	1.2	16.8	-	56.2
Experimental Field Station	0.3	-	1.3	13.0	-	48.2
Sand Dunes Tower	0.3	-	0.9	11.1	-	43.0
Van Buren Avenue	0.2	-	1.2	11.0	-	39.6
Boundary Locations						
Atomic City	0.4	-	1.6	16.8	-	69.6
Howe	0.3	-	1.0	11.3	-	37.8
Monteview	0.2	-	1.2	14.1	-	49.8
Mud Lake	0.3	-	2.1	15.3	-	75.5
Distant Locations						
Craters of the Moon	0.1	-	0.7	9.2	-	27.1
Fort Hall ¹	0.5	-	1.4	18.6	-	51.6
Idaho Falls – HVP 3804	0.3	-	1.0	13.6	-	40.4
Idaho Falls – HVP 4304	0.3	-	0.9	11.7	-	28.6

¹Operated by Shoshone-Bannock Tribes.

Note: Concentrations are expressed in 1×10^{-3} pCi/m³.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2018.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides	
	Concentration	± 2 SD	Concentration	MDC
On-site Locations				
Big Lost River Rest Area	103.6	5.5	<MDC ²	
Experimental Field Station	79.7	4.4	<MDC	
Sand Dunes Tower	73.6	3.9	<MDC	
Van Buren Avenue	64.4	3.6	<MDC	
Boundary Locations				
Atomic City	123.4	6.4	<MDC	
Howe	69.0	3.8	<MDC	
Monteview	84.7	4.6	<MDC	
Mud Lake	104.3	5.6	<MDC	
Distant Locations				
Craters of the Moon	73.1	3.9	<MDC	
Fort Hall ¹	117.0	6.2	<MDC	
Idaho Falls – HVP 3804	104.0	5.5	<MDC	
Idaho Falls – HVP 4304	80.1	4.4	<MDC	

¹Operated by Shoshone-Bannock Tribes.

²MDC for Cs-137 typically $(0.05-0.10) \times 10^{-3}$ pCi/m³.

Note: Concentrations are reported in 1×10^{-3} pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2018.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.16	0.26	0.43
Experimental Field Station	-0.16	0.34	0.58
Sand Dunes Tower	0.09	0.21	0.35
Van Buren Avenue	0.10	0.30	0.49
Boundary Locations			
Atomic City	-0.08	0.34	0.56
Howe	-0.05	0.32	0.52
Mud Lake	0.04	0.19	0.32
Monteview	0.17	0.24	0.39
Distant Locations			
Craters of the Moon	0.13	0.23	0.38
Fort Hall ¹	-0.03	0.36	0.57
Idaho Falls	0.21	0.27	0.46

¹Operated by Shoshone-Bannock Tribes.

Note: Concentrations are reported in pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 5. Tritium and Cesium-137 concentrations from precipitation, first quarter, 2018.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	70	120	190	0.0	1.9	3.3
Boundary Locations						
Atomic City	40	110	190	0.3	1.1	2.0
Howe	10	110	190	2.5	2.2	3.6
Monteviu	-30	110	190	-1.0	1.9	3.2
Mud Lake	40	120	190	-1.4	2.1	3.5
Distant Locations						
Idaho Falls	-40	110	190	NS ¹	NS ¹	NS ¹

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

¹NS – Insufficient sample volume to perform gamma spectroscopy for Cs-137.

Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2017.

Station Location	⁹⁰ Sr			²³⁸ Pu			^{239/240} Pu			²⁴¹ Am		
	Value ¹	±2SD	MDC	Value ¹	± 2SD	MDC	Value ¹	±2SD	MDC	Value ¹	±2SD	MDC
On-Site Locations												
Rest Area	4.1	5.6	10.3	0.4	3.1	6.0	0.8	1.8	3.3	0.5	2.2	4.2
EFS ³	8.1	5.8	10.5	-2.0	2.6	6.0	0.0	1.5	2.4	1.9	3.2	5.6
Sand Dunes	2.0	4.6	8.6	2.4	2.8	4.5	0.9	1.2	2.1	2.4	2.6	4.1
Van Buren	3.3	5.2	9.6	1.9	3.1	5.3	0.5	1.3	2.5	0.3	2.7	5.1
Boundary Locations												
Atomic City	0.0	8.6	15.9	-1.0	3.2	6.3	0.9	1.3	0.8	1.7	2.6	4.4
Howe	5.9	5.5	9.8	0.3	2.8	5.4	1.0	1.7	3.0	2.2	3.0	5.0
Monteviu	-0.5	5.3	10.2	-2.0	2.6	5.6	2.0	1.6	1.9	0.8	2.0	3.7
Mud Lake	-4.7	4.9	9.7	2.3	3.9	6.7	0.0	1.3	2.1	2.1	2.9	4.8
Distant Locations												
Craters of Moon	3.4	5.6	10.3	-1.7	3.2	6.6	0.3	1.7	3.4	-0.5	2.8	5.6
Fort Hall ²	-2.9	17.3	33.3	6.2	13.1	23.2	6.2	5.8	7.6	0.1	8.1	16.1
Idaho Falls 3804	1.7	5.6	10.5	1.1	3.2	5.9	0.9	1.4	2.2	3.3	2.6	3.6
Idaho Falls 4304	4.7	5.3	9.5	-1.6	2.7	5.9	2.4	2.2	3.0	3.5	3.2	4.7

Note: Concentrations are reported in 1×10^{-6} pCi/m³ with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar year.

¹ Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons. DEQ-INL OP's action levels of 190 for americium-241, 1900 for strontium-90, 210 for plutonium-238, and 200 for plutonium-239/240 (in 1×10^{-6} pCi/m³) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.

² Operated by Shoshone-Bannock Tribes. In 2017 the Ft. Hall TSP sampler operated for 20 of the 52 weeks.

³ Experimental Field Station.

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the first quarter of 2018 (**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 a high-pressure ion chamber (HPIC) (**Table 7**).

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

HPICs 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 HPICs at each location are radioed to DEQ-INL OP and presented graphically via the worldwide web at <http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx>.

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 HPICs for first quarter 2018. **Table 9** lists the EIC monitoring results for first quarter 2018. 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	
	HPIC	EIC
On-site Locations		
Base of Howe	■	■
Big Lost River Rest Area	■	■
Experimental Field Station		■
Rover	■	■
Sand Dunes Tower	■	■
Van Buren Avenue		■
Boundary Locations		
Atomic City	■	■
Big Southern Butte	■	■
Howe Met Tower	■	■
Monteview	■	■
Mud Lake/Terreton	■	■
Distant Locations		
Craters of the Moon		■
Fort Hall	■	■
Idaho Falls	■	■

Table 8. Average gamma exposure rates, first quarter, 2018, from HPIC network.

Station Location	Exposure Rate ($\mu\text{R/hr}$)	
	Quarterly Average	± 2 SD
On-site Locations		
¹ Base of Howe	--	--
Big Lost River Rest Area	13.3	1.2
Rover	12.5	2.2
Sand Dunes Tower	12.4	0.9
Boundary Locations		
Atomic City	13.8	7.7
Big Southern Butte	12.9	1.5
Howe Met Tower	12.0	0.9
¹ Monteview	--	--
¹ Mud Lake / Terreton	--	--
Distant Locations		
Fort Hall	12.3	0.9
Idaho Falls	11.0	1.1

¹No data available for this location for first quarter 2018 due to electronic malfunctions in instrumentation.

Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2018.

Station Location	Exposure Rate ($\mu\text{R/hr}$)	
	Quarterly Average ¹	± 2 SD
On-Site Locations		
Base of Howe	16.1	0.4
Big Lost River Rest Area	13.1	1.9
Experimental Field Station	13.6	0.8
Rover	18.5	1.2
Sand Dunes Tower	13.4	2.3
Van Buren Avenue	17.6	2.6
Boundary Locations		
Atomic City	11.1	2.2
Big Southern Butte	15.2	1.5
Howe Met Tower	11.5	2.0
Monteview	9.4	0.7
Mud Lake/Terreton	11.9	1.2
Distant Locations		
Craters of the Moon	8.5, 9.7	
Fort Hall	11.9	1.7
Idaho Falls	9.7	0.9

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

The DEQ-INL OP collects water samples at sites within and downgradient from the INL in order to identify INL-related impacts to the eastern Snake River Plain aquifer, evaluate trends of known INL contaminants, and verify DOE and USGS monitoring results. Samples are collected from groundwater (wells and springs), surface water (streams), and wastewater, with the vast majority being from groundwater. Most sites sampled by DEQ-INL OP are sampled concurrently with a DOE contractor or the USGS. DEQ-INL OP annually compares its own analytical results with those obtained by co-samplers to evaluate consistency. A summary of this comparison is published in the annual ESP report.

Each water-monitoring site is categorized as upgradient, facility, boundary, distant, surface water, or wastewater depending on its location (**Figure 2** and **Figure 3**). Upgradient sites are situated north and northeast of INL facilities and have not been affected by INL operations. Facility sites are near facility complexes within the INL, including the Idaho Nuclear Technology and Engineering Center (INTEC), the Advanced Test Reactor Complex (ATR), Test Area North (TAN), the Radioactive Waste Management Complex (RWMC), the Central Facilities Area (CFA), the Materials and Fuels Complex (MFC), and the Naval Reactors Facility (NRF). Many facility sites are in areas of known contamination and are sampled to monitor trends of specific contaminants. Boundary sites are on or near the southern boundary of the INL, downgradient of potential sources of INL contamination. Distant sites are farther downgradient of the INL, primarily in the Magic Valley, and include wells and springs used for agricultural, municipal, domestic, and industrial purposes. Surface water and wastewater samples are collected from locations within and upgradient of the INL.

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, gamma-emitting radionuclides, tritium,

common ions, trace metals, and nutrients.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, which has a minimum detectable concentration (MDC) of about 10-14 pCi/L. Selected sites are also sampled for specific radionuclides—including uranium isotopes (²³⁴U, ²³⁵U, and ²³⁸U), plutonium isotopes (²³⁸Pu, ^{239/240}Pu), americium-241 (²⁴¹Am), strontium-90 (⁹⁰Sr), and technetium-99 (⁹⁹Tc)—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 may be collected and analyzed for specific radionuclides.

During the first quarter of 2018, DEQ-INL-OP sampled water at one facility location—well USGS 123 at the Idaho CERCLA Disposal Facility (ICDF) at INTEC—and no other locations. Analytical results are reported in **Tables 10 through 18** and summarized below.

Gross alpha and gross beta radioactivity were detected in the sample collected this quarter at levels that are within the range of naturally occurring radioactivity determined by historical DEQ data.² Gamma-emitting radionuclides, including ¹³⁷Cs, were not detected. The sample did not exceed the EPA drinking water maximum contaminant level (MCL) of 15 pCi/L for alpha particles or the MCL of 4 mrem/year for beta and gamma emitters (equivalent to 8 pCi/L if the source is ⁹⁰Sr, 900 pCi/L if ⁹⁹Tc, 20,000 pCi/L if tritium, or 200 pCi/L if ¹³⁷Cs). Results for gross alpha, gross beta, and ¹³⁷Cs radioactivity are presented in **Table 10**.

Uranium isotopes, ⁹⁰Sr, and ⁹⁹Tc were analyzed in the sample collected this quarter. ²³⁴U and ²³⁸U were detected at background-level concentrations³ (**Table 11**). The ²³⁴U/²³⁸U ratio indicates a natural origin. ⁹⁰Sr was not detected (**Table 12**). ⁹⁹Tc was detected at a concentration of 1.7 ± 0.2 pCi/L (**Table 13**), consistent with prior measurements for this location.

The tritium concentration measured by the standard method in the sample collected this quarter was 1990 ± 240 pCi/L (**Table 14**), which is lower than previous measurements and consistent with the nearly continuous decrease in tritium concentrations observed in this well since DEQ-INL OP first sampled it in 2007. This sample was not analyzed for tritium using the enrichment method; however, enriched analyses were completed for sixteen samples collected in previous quarters and are presented in **Table 15**. Tritium was detected above background levels in two of these samples: one from A11A31, located near RWMC, and one from the 1258-foot depth of multilevel-monitoring-well USGS-103, located along the southern INL boundary. All measured concentrations are consistent with previous results. A backlog of 53 samples to be analyzed by the enrichment method remains.

Metals, common ions, and nutrients were analyzed in the sample collected this quarter (**Tables 16, 17, and 18**). All concentrations were below their respective drinking water MCLs and consistent with results from previous years.

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 only for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second and fourth quarters. Samples for common ions, trace metals, and nutrients are collected at these locations during the third quarter.

² This range is given in the INL Oversight Annual Report published by DEQ-INL OP each year.

³ Background concentrations of uranium isotopes in the eastern Snake River Plain aquifer can be found in: Bartholomay, R. C. and Hall, L. F., 2016, Evaluation of background concentrations of selected chemical and radiochemical constituents in water from the eastern Snake River Plain aquifer at and near the Idaho National Laboratory, Idaho: U.S. Geological Survey Scientific Investigations Report 2016-5056 (DOE/ID-22237).

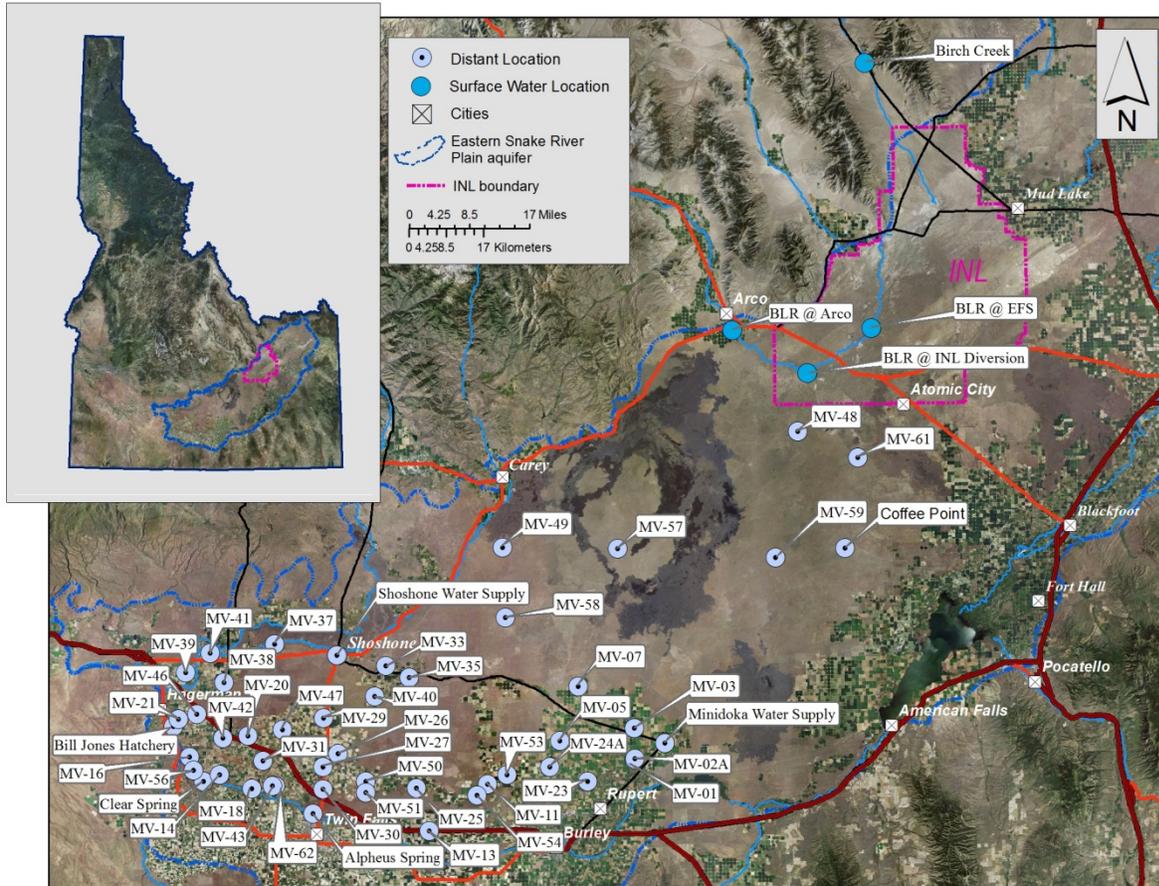


Figure 2. Distant and Surface Water monitoring locations.

Table 10. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations (pCi/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Gross Alpha		Gross Beta		Man-made gamma-emitting radionuclide Cesium-137	
		Concentration	±2 SD	Concentration	±2 SD	Concentration	±2 SD
Facility							
USGS-123	3/6/2018	3.0	1.0	4.1	0.9	-0.3	U 1.2

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

Table 11. Uranium isotope concentrations (pCi/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Uranium-234		Uranium-235		Uranium-238	
		Concentration	±2 SD	Concentration	±2 SD	Concentration	±2 SD
Facility							
USGS-123	3/6/2018	1.23	0.28	0.022	U 0.036	0.73	0.20

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

Table 12. Strontium-90 concentrations (pCi/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Strontium-90	
		Concentration	±2 SD
Facility			
USGS-123	3/6/2018	0.08	U 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.

Table 13. Technetium-99 concentrations (pCi/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Technetium-99	
		Concentration	±2 SD
Facility			
USGS-123	3/6/2018	1.7	0.2

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

Table 14. Tritium concentrations (pCi/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Tritium	
		Concentration	±2 SD
Facility			
USGS-123	3/6/2018	1990	240

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

Table 15. Enriched tritium concentrations (pCi/L) in water samples collected during various quarters and analyzed in the first quarter of 2018.

Sample Location	Sample Date	Enriched Tritium		
		Concentration		±2 SD
Upgradient				
Site-14	10/20/2016	15		7
USGS-019	4/25/2017	5	U	7
Facility				
A11A31	11/2/2016	100		9
NRF-06	5/17/2016	27		9
USGS-060	10/19/2016	7	U	9
Boundary				
USGS-008	4/20/2017	15		9
USGS-103 (1258 ft bls)	6/14/2016	210		12
USGS-124	4/19/2017	38		8
Distant				
Alpheus Spring	8/25/2016	15		7
Clear Spring	8/3/2017	-2	U	8
MV-11	7/25/2017	15		7
MV-13	7/18/2016	31		9
MV-30	7/25/2017	13		8
MV-50	7/25/2017	13		6
MV-53	7/18/2016	14		7
Wastewater				
ATR Cold Waste Pond	10/18/2016	20		6

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
 ft bls = feet below land surface.

Table 16. Dissolved metals concentrations (µg/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Concentration															
		Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc								
Facility																	
USGS-123	3/6/2018	<2.0	U	49		6.2		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U

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.

Table 17. Common ion concentrations (mg/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Concentration								
		Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity [†]	
Facility										
USGS-123	3/6/2018	40	15	10	2.8	<0.20	U	23.2	22.0	129

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.

* Sample was filtered in the field.

[†] As CaCO₃.

Table 18. Dissolved nutrient concentrations (mg/L) in water samples, first quarter, 2018.

Sample Location	Sample Date	Concentration	
		Nitrite + Nitrate	Phosphorus
Facility			
USGS-123	3/6/2018	1.2	0.021

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.

Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants, and provide independent verification of DOE's terrestrial monitoring programs. Physical soil sampling and *in-situ* gamma spectrometry are used to characterize actual deposition and accumulation of radioactive contaminants in soils. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. No *in-situ* gamma spectroscopic measurements were performed, nor were any soil samples physically collected during the first calendar quarter of 2018.

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 19**. ^{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 19. Gamma spectroscopy analysis data for milk samples, first quarter, 2018.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131 ¹
		Concentration ³	± 2 SD	
Monitoring Samples				
Gooding/Glanbia	01/18/2018	1512	123	<MDC
	02/20/2018	1296	108	<MDC
	03/06/2018	1424	119	<MDC
Riverside	03/11/2018	1623	102	<MDC
Verification Samples²				
Terreton	01/02/2018	1420	93	<MDC
Rupert	01/02/2018	1492	123	<MDC
Dietrich	02/05/2018	1433	119	<MDC
Idaho Falls	02/06/2018	1541	125	<MDC
Howe	03/05/2018	1388	92	<MDC
Rupert	03/05/2018	1526	124	<MDC

¹ <MDC – Less than Minimum Detectable Concentration (approximately 4 pCi/L for iodine-131).

² DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.

³ Concentrations with associated uncertainties (±2 SD) are expressed in pCi/L.

Quality Assurance

The measurement of any physical quantity is subject to inaccuracy from errors that may be introduced during sample collection, measurement, calibration, and the reading and reporting of results. While all of these inaccuracies cannot be quantified with certainty for each analytical result, a quality assurance program can evaluate the overall quality of a data set and, in many cases, identify and address errors or inaccuracies. The DEQ-INL OP quality assurance program is designed to (1) ensure sample integrity, (2) ensure precision and accuracy in the analytical results, and (3) ensure that the environmental data are representative and complete.

This section summarizes the results of the quality assurance (QA) assessment of the data collected for the first quarter of 2018 for the DEQ-INL OP's ESP (Environmental Surveillance Program). It also summarizes the quality control (QC) samples (blanks, duplicates, and spikes) submitted to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses and to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses during the quarter. All analyses and QC measures at the analytical laboratories used by the ESP are performed in accordance with approved written procedures maintained by each respective analytical laboratory. Sample collection is performed in accordance with written procedures maintained by the DEQ-INL OP.

Analytical results for blanks, duplicates, and spikes are used to assess the representativeness, precision, and accuracy of results from analyzing laboratories. During the first quarter of 2018, the DEQ-INL OP submitted 45 QC samples for various radiological and non-radiological analyses (**Table 20**).

Blank Samples

Blank samples consist of matrices that have negligible, acceptably low, or immeasurable amounts of the analyte(s) of interest in them. They are used to monitor for contamination introduced during sample collection, storage, shipment, and analysis.

For all analyses except enriched tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For enriched tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 30 pCi/L.⁴ 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.

Blank sample results submitted for gross alpha and gross beta screening in air for the first quarter of 2018 are presented in **Table 21**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 22**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 23**. Blank analysis results for radiochemical separation analyses for TSP particulate filters collected during 2017 are presented in **Table 24**. Blank sample results for enriched tritium in water are presented in **Table 25**.

All blank sample results passed acceptance criteria in the first quarter of 2018.

⁴ Cosmogenic tritium and tritium produced by above-ground testing of nuclear weapons during the 20th century occur at measureable concentrations in the water used by DEQ-INL OP to create blank samples. The highest tritium concentration that DEQ considers acceptable in a blank is calculated as the mean tritium concentration in DEQ blanks from 2012 to 2016 plus two standard deviations.

Duplicate Samples

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

The difference between the results of an original and duplicate sample (referred to below as a “duplicate-sample pair”) is evaluated differently for radiological and non-radiological analyses. For radiological analyses, the results of a duplicate-sample pair are considered to be in acceptable 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

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

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

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

A duplicate groundwater sample was analyzed for enriched tritium in the first quarter of 2018. The results passed acceptance criteria and are presented in **Table 26**.

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 acceptable if the percent recovery is $100 \pm 25\%$. 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 are qualified as low-biased estimates (J-), and below-MDC results are qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples are qualified as high-biased estimates (J+), and below-MDC results are qualified as undetected (U). If the percent recovery of a spiked sample is $<50\%$ or $>150\%$, the results of all associated samples are 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).

No spiked samples were analyzed during the first quarter of 2018.

DEQ-INL OP also prepares additional “spike-like” quality control samples to assess ambient radiation measurement bias. Once per quarter, DEQ-INL OP irradiates a number of 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 $100 \pm 25\%$ when compared to the known irradiated quantity. The irradiation results for first quarter 2018 are presented in **Table 27**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. All EIC spiked samples passed the DEQ-INL OP criteria.

Laboratory QC Issues

There were no laboratory QC issues in the first quarter of 2018.

Analytical QA/QC Assessment

No issues involving sample chain of custody, sample holding times, or the analysis of blank, duplicate, and spiked samples were observed during the first quarter of 2018 which significantly affected data quality. Methodologies and data reports issued by the contracting laboratories conformed to the requirements of DEQ-INL OP during the first quarter of 2018.

Data usability is the measure of data that is not rejected compared to the amount that was expected to be obtained. The overall data usability rate for the first quarter of 2018 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 12**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the first quarter of 2018 the TSP blower at the Idaho Falls sampling station was replaced. Service reliability for air sampling equipment for the first quarter of 2018 is summarized in **Table 20**.

Conclusion

All data collected for the first quarter of 2018 have been assigned the applicable qualifiers to designate the appropriate use of the data. In addition, all data has been verified and deemed complete, meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 20. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, first quarter, 2018.

Media Sampled	Collection Device	Analyte	Test Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected ¹	Analyzing Lab ²
Air								
Particulate	4-inch filter	Gross alpha	155	13	0	0	1	ISU-EML
		Gross beta	155	13	0	0	1	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	48	4	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	21	3	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	5	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	1	0	0	0	0	ISU-EML
		Gross beta	1	0	0	0	0	ISU-EML
		Gamma emitters	1	0	0	0	0	ISU-EML
		Tritium	1	0	0	0	0	ISU-EML
		Enriched tritium	0	1	1	0	0	ISU-EML
		Technetium-99	1	0	0	0	0	ISU-EML
		Radiochemical	2	0	0	0	0	ISU Sub
		Metals	1	0	0	0	0	IBL
		Common Ions	1	0	0	0	0	IBL
Nutrients	1	0	0	0	0	IBL		
Volatile Organics	0	0	0	0	0	IBL		
Terrestrial								
Milk	Grab or composite	Gamma emitters	10	0	0	0	0	ISU-EML
Soil	<i>in situ</i>	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – “puck”	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	65	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	10	NA	NA	NA	0	DEQ-INL OP
Total Test Analyses			510	35	1	9	2	
Total of QC Analyses (blanks, duplicates, and spikes)			45					
Percentage of QC analyses of total Test analyses³			8.8%					
Percentage of usable data⁴			99.6%					

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

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

³ Analyzing quality control samples at a rate of approximately 5 to 10 percent of the total number of test analyses performed for the year is deemed appropriate for the DEQ-INL OP ESP.

⁴ Data usability rate [total analyses – rejected data]/[total analyses] of 90 percent or higher is acceptable for the DEQ-INL OP ESP.

Table 21. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2018.

Collection Period		Corrected volume (m ³) ¹	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
12/28/17	01/04/18	2020	0.0	0.1	0.4	0.5
01/04/18	01/11/18	2020	0.0	0.1	0.1	0.5
01/11/18	01/18/18	2020	0.0	0.1	0.3	0.5
01/18/18	01/25/18	2020	-0.1	0.1	0.1	0.5
01/25/18	02/01/18	2020	0.0	0.1	-0.1	0.5
02/01/18	02/08/18	2020	0.1	0.1	0.1	0.5
02/08/18	02/15/18	2020	0.0	0.1	-0.1	0.5
02/15/18	02/22/18	2020	0.0	0.1	0.4	0.5
02/22/18	03/01/18	2020	0.0	0.1	-0.2	0.5
03/01/18	03/08/18	2020	0.1	0.1	0.4	0.5
03/08/18	03/15/18	2020	0.0	0.1	0.0	0.5
03/15/18	03/22/18	2020	0.1	0.1	0.1	0.5
03/22/18	03/29/18	2020	0.1	0.1	-0.1	0.5

Note: Concentrations and associated uncertainties (± 2 SD) are expressed in 1 x 10⁻³ pCi/m³.

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

Table 22. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2018.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/15/18	-4	35	59	-97	103	178	4	12	20
Analysis Date	Cesium-134			Cesium-137					
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC			
04/15/18	0	4	7	0	6	9			

Note: Concentrations are expressed in 1 x 10⁻⁵ pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

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

Table 23. Blank analysis results for tritium in water vapor from air samples, first quarter, 2018.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP181ZTR01	04/16/18	04/18/18	05/02/18	0.04	0.08	0.14
OP181ZTR02	04/16/18	04/18/18	04/24/18	-0.02	0.09	0.15
OP181ZTR03	04/16/18	04/18/18	04/24/18	-0.05	0.08	0.15

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

Table 24. Blank analysis results for 2017 TSP annual radiochemical composites of air filters.

Location	⁹⁰ Sr			²³⁸ Pu			²³⁹ Pu/ ²⁴⁰ Pu			²⁴¹ Am		
	Value ¹	± 2 SD	MDC	Value ¹	± 2 SD	MDC	Value ¹	± 2 SD	MDC	Value ¹	± 2 SD	MDC
Blank	-0.34	0.50	0.98	0.09	0.33	0.61	0.14	0.17	0.27	0.13	0.28	0.50

Note: Concentrations are expressed in 1 x 10⁻⁵ pCi/m³ 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 year. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute “air concentrations” for the blank for meaningful comparison to sample results. No air was actually passed through the blank filters.

Table 25. Blank analysis results (pCi/L) for radiological constituents in water, first quarter, 2018.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Enriched Tritium					
161W591	11/2/2016	30	9	13	Yes

MDC = minimum detectable concentration.

Table 26. Duplicate sample results (pCi/L) for radiological constituents in groundwater and surface water, first quarter, 2018.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	R ₁ -R ₂	$3(S_1^2+S_2^2)^{1/2}$	Within Criteria?
Enriched Tritium									
USGS-060	161W693	7	9	161W711	13	8	6	18	Yes

Table 27. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2018.

Electret #	Exposure Received		Net Measured Exposure ¹		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SJE132	45.0	2.2	42.7	1.4	94.9%	Y
SJE219	45.0	2.2	41.2	1.4	91.6%	Y
SJE169	45.0	2.2	40.9	1.4	90.9%	Y
Triplicate AVG:					92.5%	Y
SJE106	30.3	1.5	27.5	1.4	90.8%	Y
SJE007	30.3	1.5	25.8	1.4	85.1%	Y
SJE119	30.3	1.5	29.9	1.4	98.7%	Y
Triplicate AVG:					91.5%	Y
SJE035	20.0	1.0	17.6	1.4	88.0%	Y
SJE021	20.0	1.0	18.7	1.4	93.5%	Y
SJE204	20.0	1.0	18.7	1.4	93.5%	Y
Triplicate AVG:					91.7%	Y

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

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

Table 28. Air sampling field equipment service reliability (percent operational), first quarter, 2018.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	100%	100%	100%	100%
Experimental Field Station	100%	100%	100%	NC ¹
Sand Dunes Tower	100%	100%	100%	NC ¹
Van Buren Avenue	100%	100%	100%	NC ¹
Boundary Locations				
Atomic City	100%	100%	100%	100%
Howe	100%	100%	100%	100%
Monteview	100%	100%	100%	100%
Mud Lake	100%	100%	100%	100%
Distant Locations				
Craters of the Moon	100%	100%	100%	NC ¹
Idaho Falls	92%	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.

Appendix A

Table A-1. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2018.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	12/28/17	01/04/18	1.2	0.3	46.6	1.5
	01/04/18	01/11/18	1.2	0.3	56.2	1.6
	01/11/18	01/18/18	0.7	0.2	29.0	1.2
	01/18/18	01/25/18	0.5	0.2	28.2	1.2
	01/25/18	02/01/18	0.3	0.2	22.1	1.1
	02/01/18	02/08/18	0.4	0.2	18.3	1.0
	02/08/18	02/15/18	0.9	0.2	33.1	1.3
	02/15/18	02/22/18	0.5	0.2	19.3	1.0
	02/22/18	03/01/18	0.6	0.2	23.8	1.1
	03/01/18	03/08/18	0.6	0.2	20.8	1.0
	03/08/18	03/15/18	0.6	0.2	29.6	1.2
	03/15/18	03/22/18	0.4	0.2	16.8	0.9
	03/22/18	03/29/18	0.5	0.2	19.5	1.0
Experimental Field Station	12/28/17	01/11/18 ¹	1.3 ¹	0.2 ¹	48.2 ¹	1.2 ¹
	01/11/18	01/18/18	0.6	0.2	21.4	1.1
	01/18/18	01/25/18	0.5	0.2	22.1	1.1
	01/25/18	02/01/18	0.4	0.2	16.6	1.0
	02/01/18	02/08/18	0.3	0.2	13.0	0.9
	02/08/18	02/15/18	0.5	0.2	23.4	1.1
	02/15/18	02/22/18	0.3	0.2	14.1	0.9
	02/22/18	03/01/18	0.5	0.2	16.8	1.0
	03/01/18	03/08/18	0.4	0.2	15.0	0.9
	03/08/18	03/15/18	0.5	0.2	20.0	1.1
	03/15/18	03/22/18	0.3	0.2	13.8	0.9
03/22/18	03/29/18	0.6	0.2	13.2	0.9	
Sand Dunes Tower	12/28/17	01/04/18	0.6	0.2	39.5	1.3
	01/04/18	01/11/18	0.9	0.2	43.0	1.4
	01/11/18	01/18/18	0.6	0.2	20.2	1.0
	01/18/18	01/25/18	0.4	0.2	17.5	0.9
	01/25/18	02/01/18	0.4	0.2	14.1	0.9
	02/01/18	02/08/18	0.5	0.2	13.9	0.9
	02/08/18	02/15/18	0.4	0.2	23.2	1.0
	02/15/18	02/22/18	0.4	0.2	12.1	0.8
	02/22/18	03/01/18	0.4	0.2	17.5	0.9
	03/01/18	03/08/18	0.4	0.2	14.1	0.8
	03/08/18	03/15/18	0.3	0.2	18.9	1.0
	03/15/18	03/22/18	0.3	0.2	11.7	0.8
	03/22/18	03/29/18	0.3	0.1	11.1	0.8

¹Filter on sampler for 2 weeks – filter was not exchanged on 1/4/2018.

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2018.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/28/17	01/04/18	1.2	0.3	32.0	1.2
	01/04/18	01/11/18	1.1	0.3	39.6	1.4
	01/11/18	01/18/18	0.4	0.2	18.0	1.0
	01/18/18	01/25/18	0.4	0.2	15.2	0.9
	01/25/18	02/01/18	0.4	0.2	12.7	0.8
	02/01/18	02/08/18	0.3	0.2	11.4	0.8
	02/08/18	02/15/18	0.3	0.2	19.6	1.0
	02/15/18	02/22/18	0.2	0.2	11.2	0.8
	02/22/18	03/01/18	0.4	0.2	13.9	0.9
	03/01/18	03/08/18	0.3	0.1	14.4	0.9
	03/08/18	03/15/18	0.3	0.2	16.1	0.9
	03/15/18	03/22/18	0.4	0.2	11.0	0.8
	03/22/18	03/29/18	0.4	0.2	11.2	0.8
Boundary Locations						
Atomic City	12/28/17	01/04/18	1.1	0.3	59.3	1.6
	01/04/18	01/11/18	1.5	0.3	69.6	1.7
	01/11/18	01/18/18	0.8	0.2	35.3	1.3
	01/18/18	01/25/18	0.7	0.2	31.2	1.2
	01/25/18	02/01/18	1.0	0.3	24.3	1.1
	02/01/18	02/08/18	0.6	0.2	19.6	1.0
	02/08/18	02/15/18	1.6	0.3	43.3	1.4
	02/15/18	02/22/18	0.6	0.2	16.8	1.0
	02/22/18	03/01/18	0.4	0.2	19.8	1.0
	03/01/18	03/08/18	0.8	0.2	26.4	1.1
	03/08/18	03/15/18	0.6	0.2	22.8	1.1
	03/15/18	03/22/18	0.4	0.2	18.1	1.0
	03/22/18	03/29/18	0.6	0.2	16.9	1.0
Howe	12/28/17	01/04/18	0.8	0.2	29.7	1.2
	01/04/18	01/11/18	1.0	0.2	37.8	1.4
	01/11/18	01/18/18	0.5	0.2	19.7	1.0
	01/18/18	01/25/18	0.5	0.2	19.3	1.0
	01/25/18	02/01/18	0.4	0.2	13.7	0.9
	02/01/18	02/08/18	0.5	0.2	13.4	0.9
	02/08/18	02/15/18	0.6	0.2	20.0	1.0
	02/15/18	02/22/18	0.7	0.2	13.6	1.0
	02/22/18	03/01/18	0.5	0.2	14.5	0.9
	03/01/18	03/08/18	0.6	0.2	18.5	1.0
	03/08/18	03/15/18	0.5	0.2	17.4	1.0
	03/15/18	03/22/18	0.3	0.2	11.3	0.8
	03/22/18	03/29/18	0.3	0.2	12.4	0.9

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2018.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Montevieu	12/28/17	01/04/18	1.2	0.3	42.3	1.4
	01/04/18	01/11/18	1.2	0.3	49.8	1.5
	01/11/18	01/18/18	0.6	0.2	24.8	1.1
	01/18/18	01/25/18	0.4	0.2	20.5	1.1
	01/25/18	02/01/18	0.4	0.2	20.7	1.1
	02/01/18	02/08/18	0.7	0.2	20.6	1.1
	02/08/18	02/15/18	0.6	0.2	26.3	1.2
	02/15/18	02/22/18	0.5	0.2	16.1	1.0
	02/22/18	03/01/18	0.3	0.2	20.2	1.1
	03/01/18	03/08/18	0.4	0.2	15.0	0.9
	03/08/18	03/15/18	0.4	0.2	21.6	1.1
	03/15/18	03/22/18	0.2	0.2	14.1	0.9
	03/22/18	03/29/18	0.4	0.2	14.1	0.9
Mud Lake	12/28/17	01/04/18	1.6	0.3	59.0	1.9
	01/04/18	01/11/18	2.1	0.4	75.5	2.1
	01/11/18	01/18/18	0.7	0.2	31.7	1.3
	01/18/18	01/25/18	0.8	0.2	31.3	1.2
	01/25/18	02/01/18	0.3	0.2	21.5	1.1
	02/01/18	02/08/18	0.7	0.2	24.8	1.1
	02/08/18	02/15/18	0.8	0.2	33.1	1.3
	02/15/18	02/22/18	0.7	0.2	18.4	1.0
	02/22/18	03/01/18	0.5	0.4	30.0	2.1
	03/01/18	03/08/18	0.6	0.2	19.1	1.0
	03/08/18	03/15/18	0.7	0.2	26.3	1.2
	03/15/18	03/22/18	0.6	0.2	15.3	1.0
	03/22/18	03/29/18	1.1	0.2	21.9	1.0
Distant Locations						
Craters of the Moon	12/28/17	01/04/18	0.4	0.2	17.6	1.0
	01/04/18	01/11/18	0.6	0.2	27.1	1.1
	01/11/18	01/18/18	0.3	0.2	13.2	0.9
	01/18/18	01/25/18	0.2	0.2	12.5	0.8
	01/25/18	02/01/18	0.1	0.2	10.6	0.8
	02/01/18	02/08/18	0.3	0.2	12.7	0.9
	02/08/18	02/15/18	0.7	0.2	22.5	1.1
	02/15/18	02/22/18	0.5	0.2	9.2	0.8
	02/22/18	03/01/18	0.2	0.2	11.3	0.8
	03/01/18	03/08/18	0.3	0.2	10.2	0.8
	03/08/18	03/15/18	0.4	0.2	15.8	0.9
	03/15/18	03/22/18	0.3	0.2	9.6	0.8
	03/22/18	03/29/18	0.3	0.1	10.8	0.8

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2018.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall¹	12/28/17	01/04/18	1.2	0.3	36.4	1.3
	01/04/18	01/11/18	1.4	0.3	51.6	1.6
	01/11/18	01/18/18	1.3	0.3	32.1	1.2
	01/18/18	01/25/18	0.5	0.2	22.3	1.1
	01/25/18	02/01/18	0.7	0.2	20.7	1.0
	02/01/18	02/08/18	0.8	0.2	20.4	1.0
	02/08/18	02/15/18	0.9	0.2	35.0	1.3
	02/15/18	02/22/18	0.5	0.2	20.1	1.0
	02/22/18	03/01/18	0.7	0.2	22.3	1.1
	03/01/18	03/08/18	0.8	0.2	24.3	1.1
	03/08/18	03/15/18	0.8	0.2	28.8	1.2
	03/15/18	03/22/18	0.7	0.2	20.3	1.0
	03/22/18	03/29/18	0.8	0.2	18.6	1.0
Idaho Falls - HVP 3804	12/28/17	01/04/18	0.9	0.3	36.7	1.3
	01/04/18	01/11/18	1.0	0.2	40.4	1.4
	01/11/18	01/18/18	0.6	0.2	23.9	1.1
	01/18/18	01/25/18	0.6	0.2	20.0	1.0
	01/25/18	02/01/18	0.4	0.2	18.3	1.0
	02/01/18	02/08/18	0.6	0.2	16.8	1.0
	02/08/18	02/15/18	0.6	0.2	29.6	1.2
	02/15/18	02/22/18	0.5	0.3	16.4	1.6
	02/27/18	03/01/18	R ³	R ³	R ³	R ³
	03/01/18	03/08/18	0.3	0.2	13.6	0.9
	03/08/18	03/15/18	0.5	0.2	23.5	1.1
	03/15/18	03/22/18	0.5	0.2	14.4	0.9
	03/22/18	03/29/18	0.5	0.2	13.7	0.9
Idaho Falls - HVP 4304²	12/28/17	01/04/18	0.7	0.2	28.6	1.2
	01/04/18	01/11/18	0.9	0.2	25.9	1.1
	01/11/18	01/18/18	0.4	0.2	16.3	0.9
	01/18/18	01/25/18	0.4	0.2	16.4	0.9
	01/25/18	02/01/18	0.3	0.2	15.8	0.9
	02/01/18	02/08/18	0.5	0.2	11.7	0.8
	02/08/18	02/15/18	0.9	0.2	27.5	1.2
	02/15/18	02/22/18	0.4	0.2	14.5	0.9
	02/22/18	03/01/18	0.6	0.2	16.9	0.9
	03/01/18	03/08/18	0.6	0.2	17.5	1.0
	03/08/18	03/15/18	0.6	0.2	23.2	1.1
	03/15/18	03/22/18	0.4	0.2	15.1	0.9
	03/22/18	03/29/18	0.8	0.2	15.5	0.9

¹ Operated by Shoshone Bannock-Tribes.

² HVP 4304 – This is a new sampler model being operated side by side with sampler HVP 3804 to test the dependability and durability in field conditions.

³ R – Results rejected due to insufficient sample volume.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2018.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
Arco	14.9	3.4
Craters of the Moon	8.5, 9.7	
Rest Area	13.1	1.9
Van Buren Avenue	17.6	2.6
Experimental Field Station	13.6	0.8
Main Gate	12.2	2.8
Atomic City	11.1	2.2
Taber	14.5	1.1
Blackfoot	10.8	2.8
Ft. Hall	11.9	1.7
Idaho Falls	9.7	0.9
Mud Lake/ Terreton	11.9	1.2
Monteview	9.4	0.7
Sand Dunes	13.4	2.3
Howe Met. Tower	11.5	2.0
MP282 -20	10.5	3.0
MP280 -20	9.8	1.4
MP278 -20	11.0	2.8
MP276 -20	12.5	3.0
MP274 -20	10.1	3.1
MP272 -20	11.9	3.5
MP270 -20	13.7	3.3
MP268 -20	12.0	1.7
MP266 -20	10.5	1.5
MP264 -20	13.3	1.9
MP270 -20/26	14.8	1.1
MP268 -20/26	14.5	2.1
MP266 -20/26	13.8	2.5
MP263 -20/26	14.6	3.3
MP261 -20/26	10.2	0.5
MP259 -20/26	12.4	1.2
MP256 -20/26	12.8	2.6
MFC (EBR II)	10.3, 11.2	
EBR I	9.1, 10.1	
RWMC	12.4	2.5
CFA	13.6	1.7
CITRC (PBF)	11.3	2.4
INTEC	12.8	0.4
ATR (TRA)	11.6, 13.1	
NRF	14.5	3.4
TAN/SMC	9.4	0.7
Mud Lake Bank of Commerce	13.4	2.7
MP43-33	13.8	2.2
MP41-33	13.4	2.0
MP39-33	12.8	0.8
MP37-33	10.9	2.3
MP35-33	12.3	3.3
MP33-33	15.0	2.8
MP31-33	11.8	1.6
MP29-33	12.9	2.3

Table B.1 cont. Results for all electret ionization chamber (EIC) locations, first quarter, 2018.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
MP27-33	14.3	2.3
MP25-33	12.8	3.1
MP23-33	10.4	1.5
MP21-33	11.8	2.9
MP19-33	11.6	1.7
MP14-33	10.5	2.6
MP11-33	9.8	1.3
MP06-33	9.4	1.7
MP03-33	10.9	2.8
Base of Howe	16.1	0.4
Rover	18.5	1.2
Hamer	13.2	1.0
Sugar City	17.1	1.8
Roberts	13.6	0.6
Big Southern Butte	15.2	1.5
T4 North	11.9	1.1
T4 South	12.0	2.7

¹Results 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.