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
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
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 first quarter, 2019 (**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. During the 1^{st} quarter of 2018 the HVP-3804 sampler at Idaho Falls air monitoring station failed and was replaced with a newer model HVP-4304 sampler. The second sampler is now being operated as a duplicate. 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 2019 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide. The MDC for Cs-137 is also reported since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

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 x 10^{-6} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation. Four results exceed the $^{89/90}$Sr MDC for the 2018 annual composite at Atomic City, Craters of the Moon, Fort Hall, and Mud Lake sampling sites. Six results exceed the ^{238}Pu MDC for the 2018 annual composite at Atomic City, Craters of the Moon, Howe, Idaho Falls, Monteview, and Rest Area sampling sites. Three results exceed the ^{239}Pu/^{240}Pu MDC for the 2018 annual composite at the Craters of the Moon, Howe, and Mud Lake sampling sites The filters were sent to a second lab for radiochemical analysis of Plutonium-238 and Plutonium-239/240 **(Table 7)**. Seven results exceed the ^{239}Pu/^{240}Pu MDC at the following sample sites: Rest Area, Experimental Field Station, Sand Dunes, Van Buren, Atomic City, Mud Lake, and Idaho Falls Duplicate. Though minimally exceeding the MDC, these 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/m^3 (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 2019. Precipitation samples were analyzed for tritium and manmade 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 manmade gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the first quarter of 2019. Analysis results for Tritium (H-3) and Cesium-137, the most likely to be detected of manmade gamma-emitting radionuclides, are presented in **Table 5**.

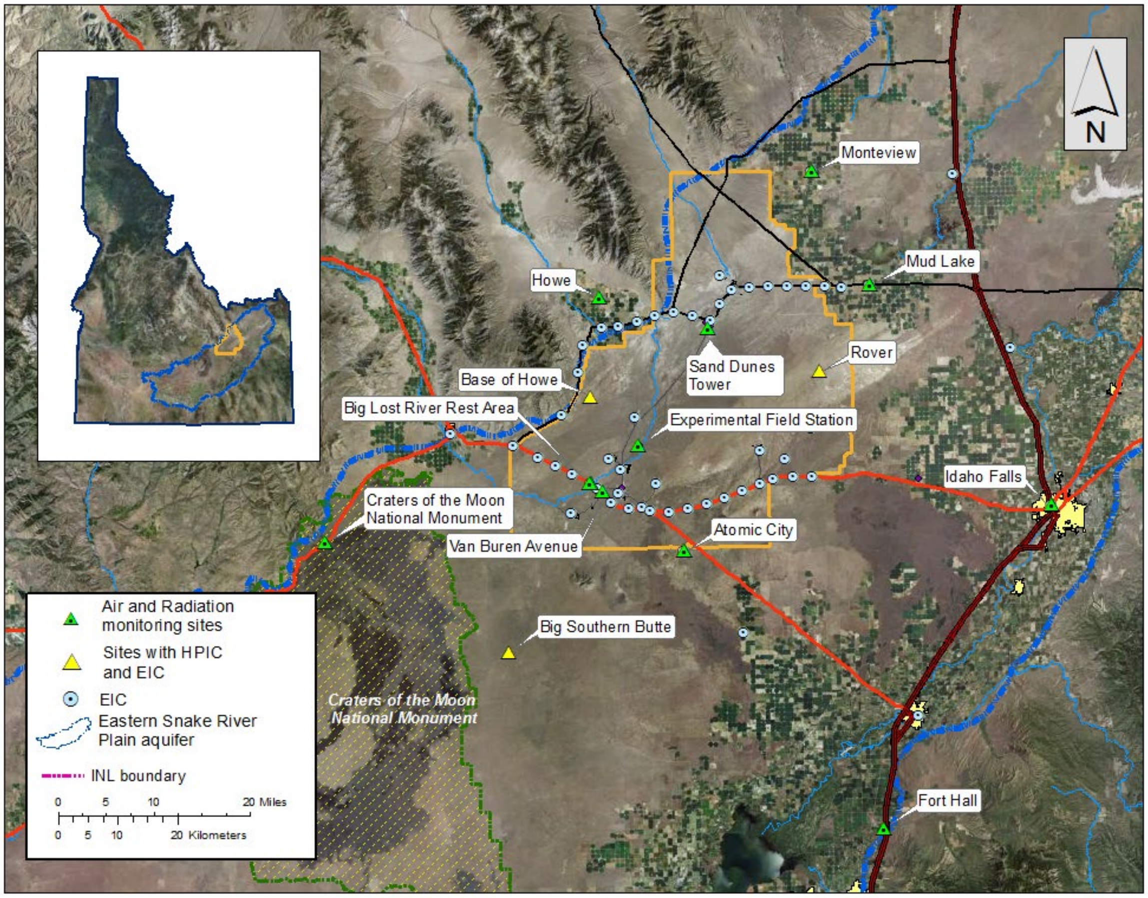

Figure 1. Air and radiation monitoring locations.

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	□	□	■	■
Experimental Field Station	□	□	■	
Sand Dunes Tower	□	□	■	
Van Buren Avenue	□	□	■	
Boundary Locations				
Atomic City	□	□	■	■
Howe	□	□	■	■
Monteview	□	□	■	■
Mud Lake	□	□	■	■
Distant Locations				
Craters of the Moon	□	□	■	
Fort Hall[2]	□	□	■	
Idaho Falls	□	□	■	■

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

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2019.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.3	-	1.2	16.8	-	52.7
Experimental Field Station	0.1	-	0.9	11.3	-	51.4
Sand Dunes Tower	0.3	-	3.3	12.5	-	45.5
Van Buren Avenue	0.2	-	0.7	8.7	-	28.3
Boundary Locations						
Atomic City	0.7	-	2.0	16.6	-	68.9
Howe	0.1	-	0.9	12.4	-	32.4
Monteview	0.2	-	0.9	12.6	-	51.2
Mud Lake	0.2	-	1.2	17.1	-	63.2
Distant Locations						
Craters of the Moon	0.1	-	0.5	7.4	-	22.8
Fort Hall[1]	0.2	-	1.6	13.1	-	61.0
Idaho Falls – HVP 4304	0.2	-	1.5	12.5	-	58.9
Idaho Falls – HVP 4304[DP]	0.2	-	1.5	11.2	-	47.2

[1]Operated by Shoshone-Bannock Tribes.
[DP]The second HVP-4304 sampler is being run as a duplicate.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2019.

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	93.9	5.2	<MDC[2]	
Experimental Field Station	64.0	3.6	<MDC	
Sand Dunes Tower	48.1	2.7	<MDC	
Van Buren Avenue	49.9	3.0	<MDC	
Boundary Locations				
Atomic City	100.6	5.3	<MDC	
Howe	53.8	3.0	<MDC	
Monteview	63.5	3.6	<MDC	
Mud Lake	80.8	4.4	<MDC	
Distant Locations				
Craters of the Moon	51.5	2.9	<MDC	
Fort Hall[1]	104.6	5.6	<MDC	
Idaho Falls – HVP 4304	102.3	5.6	<MDC	
Idaho Falls – HVP 4304[DP]	79.2	4.3	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
[DP]The second HVP-4304 sampler is being run as a duplicate.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2019.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.03	0.25	0.42
Experimental Field Station	0.30	0.30	0.50
Sand Dunes Tower	-0.02	0.20	0.33
Van Buren Avenue	0.02	0.15	0.25
Boundary Locations			
Atomic City	0.01	0.25	0.43
Howe	0.09	0.24	0.40
Mud Lake	-0.02	0.27	0.46
Monteview	0.15	0.33	0.54
Distant Locations			
Craters of the Moon	0.06	0.24	0.39
Fort Hall[1]	0.30	0.27	0.46
Idaho Falls	0.13	0.25	0.42

[1]Operated by Shoshone-Bannock Tribes.
Note: Concentrations are reported in pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 5. Tritium and gamma-emitting radionuclide concentrations from precipitation, first quarter, 2019.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	70	90	150	0.6	1.6	2.6
Boundary Locations						
Atomic City	80	90	150	0.3	1.3	2.3
Howe	10	90	150	-0.2	1.3	2.3
Monteview	140	90	150	-0.3	1.5	2.5
Mud Lake	10	90	150	-0.8	1.2	2.1
Distant Locations						
Idaho Falls	80	90	150	-0.3	1.7	2.9

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

Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2018.

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	3.6	6.2	12.0	9.9	4.2	4.7	2.7	2.2	3.0	0.0	2.2	4.3
EFS[3]	6.1	7.6	14.7	5.4	4.3	6.5	0.3	2.2	4.3	-0.4	2.8	5.6
Sand Dunes	7.1	5.7	10.5	4.0	3.6	5.8	1.2	2.0	3.5	-1.8	2.6	5.4
Van Buren	9.9	6.1	10.7	5.3	3.8	5.7	2.1	2.2	3.4	1.2	2.9	5.2
Boundary Locations												
Atomic City	18.8	8.2	13.5	7.3	3.8	4.9	2.6	2.2	3.1	1.0	2.4	4.3
Howe	10.4	7.4	13.6	7.2	3.8	4.8	4.9	2.6	2.5	0.0	1.7	3.7
Monteview	1.2	5.4	10.8	5.8	3.9	5.7	1.3	1.5	2.4	1.8	2.4	4.0
Mud Lake	19.8	8.1	13.0	1.5	2.9	5.2	2.1	1.6	0.8	0.2	2.9	5.0
Distant Locations												
Craters of Moon	14.2	6.6	10.7	7.9	4.6	6.3	2.9	2.1	2.7	1.2	2.7	4.8
Fort Hall[2]	19.1	7.3	11.4	-0.1	3.1	5.9	0.3	1.9	3.8	0.9	2.6	4.8
Idaho Falls 4304	13.9	8.2	14.5	9.6	4.7	6.1	0.3	1.9	3.8	5.5	4.1	6.0
Idaho Falls 4304[DP]	10.3	8.1	14.8	3.1	3.4	5.5	0.3	1.3	2.6	-0.6	2.7	5.3

Note: Concentrations are reported in 1 x 10^{-6} pCi/m^3 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 x 10^{-6} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.

[2] Operated by Shoshone-Bannock Tribes.

[3] Experimental Field Station.

[DP] The second HVP-4304 sampler is being run as a duplicate.

Table 7. Annual radiochemical separation second analysis data for TSP particulate filters collected during 2018.

Station Location	^{238}Pu			$^{239/240}Pu$		
	Value[1]	± 2SD	MDC	Value[1]	±2SD	MDC
On-Site Locations						
Rest Area	-0.01	0.13	0.26	0.32	0.23	0.22
EFS[3]	0.02	0.18	0.36	0.51	0.30	0.12
Sand Dunes	-0.14	0.17	0.45	0.52	0.32	0.32
Van Buren	0.04	0.15	0.23	0.29	0.22	0.23
Boundary Locations						
Atomic City	0.05	0.18	0.27	0.39	0.28	0.33
Howe	-0.08	0.13	0.37	0.01	0.13	0.21
Monteview	0.03	0.15	0.09	0.24	0.24	0.37
Mud Lake	0.06	0.16	0.31	0.39	0.27	0.31
Distant Locations						
Craters of Moon	0.02	0.19	0.37	0.02	0.19	0.37
Fort Hall[2]	0.02	0.18	0.34	0.27	0.25	0.34
Idaho Falls 4304	0.03	0.19	0.37	0.19	0.20	0.28
Idaho Falls 4304[DP]	0.06	0.18	0.29	0.25	0.21	0.12

Note: Concentrations are reported in 1 x 10^{-6} pCi/m^3 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 210 for plutonium-238, and 200 for plutonium-239/240 (in 1 x 10^{-6} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.

[2] Operated by Shoshone-Bannock Tribes.

[3] Experimental Field Station.

[DP] The second HVP-4304 sampler is being run as a duplicate.

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the first quarter of 2019 (**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 8**).

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 9** lists the average radiation exposure rates measured by the HPICs for first quarter 2019. **Table 10** lists the EIC monitoring results for first quarter 2019. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 8. 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 9. Average gamma exposure rates, first quarter, 2019, from HPIC* network.

Station Location	Exposure Rate (μR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
[1]Base of Howe	--	--
Big Lost River Rest Area	11.0	1.9
[1]Rover	-	-
Sand Dunes Tower	11.9	1.6
Boundary Locations		
Atomic City	12.5	1.8
Big Southern Butte	12.2	1.6
Howe Met Tower	11.5	1.4
Monteview	11.5	1.5
[1]Mud Lake / Terreton	-	-
Distant Locations		
Fort Hall	12.2	1.3
Idaho Falls	9.8	3.0

[1]No data available for these locations for first quarter 2019 due to electronic malfunctions / failures in instrumentation.
**The HPIC's 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.*

Table 10. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2019.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	13.3, 14.2	-
Big Lost River Rest Area	11.0	1.4
Experimental Field Station	14.9, 16.3	-
Rover	13.5, 13.8	-
Sand Dunes Tower	11.2, 13.4	-
Van Buren Avenue	14.0	1.3
Boundary Locations		
Atomic City	7.9	3.3
Big Southern Butte	16.2, 16.8	-
Howe Met Tower	12.7	0.8
Monteview	9.4, 10.5	-
Mud Lake/Terreton	15.1	1.9
Distant Locations		
Craters of the Moon	8.0	2.1
Fort Hall	10.0	1.9
Idaho Falls	8.5,11.6	-

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

Water Monitoring Results

DEQ-INL OP collects groundwater samples from wells and springs located within, upgradient of, and downgradient of the INL in order 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 80-85 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, common ions,[1] and nitrate-plus-nitrite.[2] 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, 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 first quarter of 2019, DEQ-INL OP sampled groundwater from the aquifer at one monitoring location: USGS-123 at INTEC. **Table 11** lists the sample date, co-sampler, well depth, and analyses requested for the location sampled this quarter. Analytical results are reported in **Tables 13 through 21** and summarized below. The results of low-level tritium analyses for fourteen samples collected in a previous quarter are reported in **Table 15** and discussed below.

Table 12 shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary MCL. Background concentrations depend on local geology, and the concentrations of constituents at sites not influenced by INL activities may on occasion be higher than the given background ranges due to local factors and natural variability.

Gross alpha and gross beta radioactivity

Gross alpha and gross beta analyses are used to screen for unexpectedly high levels of radioactivity in samples. DEQ-INL OP has determined from past sampling that background concentration ranges for gross alpha and gross beta radioactivity in the ESRP aquifer are approximately 0-4 pCi/L and 0-7 pCi/L, respectively. Occasional measurements of concentrations above these background ranges in uncontaminated samples are statistically probable due to uncertainties inherent in measuring low levels of radioactivity. Additionally, some samples will have levels of radioactivity slightly higher than background ranges due to higher-than-average concentrations of naturally occurring uranium, thorium, or potassium-40.

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[1] The common ions are calcium, magnesium, potassium, sodium, chloride, fluoride, sulfate, and bicarbonate (reported here as alkalinity).
[2] 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, nitrate-plus-nitrate, and other constituents are collected at these locations during the third quarter.

Gross alpha radioactivity in USGS-123 was measured at a concentration of 5.1 pCi/L, slightly higher than the known background range. Gross beta radioactivity was detected within the background range (**Table 13**). The sample did not exceed the drinking water MCL for gross alpha radioactivity. The MCL for gross beta radioactivity is nuclide-dependent; see the Strontium-90 and Technetium-99 sections below for MCL values.

Manmade gamma-emitting radionuclides

No manmade gamma-emitting radionuclides were detected at the location sampled this quarter. Results for cesium-137 (^{137}Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 13**.

Tritium

A tritium concentration of 1720 ± 150 pCi/L was measured in water from USGS-123 using the standard analytical method (**Table 14**). USGS-123 is located in a known tritium plume that extends south from INTEC. The tritium concentration at this location has been steadily decreasing since 2003. The concentration measured this quarter is the lowest measured by DEQ-INL OP to date.

Twelve low-level tritium samples from the second and third quarters of 2018 were analyzed in the second quarter of 2019, and the results are reported in **Table 15**. Two of the twelve samples are from boundary wells, and the remaining ten are from distant wells. All reported concentrations are consistent with past results.

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

Strontium-90

Strontium-90 was not detected at USGS-123 (**Table 16**). The MCL for ^{90}Sr is 8 pCi/L.

Technetium-99

Technetium-99 was not detected at USGS-123 (**Table 17**). The MCL for ^{99}Tc is 900 pCi/L.

Actinides

Uranium isotopes were analyzed in water from USGS-123 (**Table 18**). Uranium-234 and -238 were detected and uranium-235 was not. The ^{238}U concentration was slightly above the background range listed in **Table 12**, but the ^{234}U /^{238}U ratio does not indicate an enriched (i.e., manmade) source. Concentrations of uranium isotopes at this location, including the slightly above-background ^{238}U concentration, were consistent with past observations.

Plutonium isotopes and ^{241}Am were not measured this quarter.

Common ions, trace metals, and nutrients

Common ions (calcium, magnesium, potassium, sodium, chloride, sulfate, and alkalinity), chromium, and nitrate-plus-nitrite were analyzed in water from USGS-123 (**Tables 19, 20, and 21**). All concentrations were consistent with past observations and below their respective MCLs and secondary MCLs. Chromium was measured at 47 µg/L, the highest concentration since 2006, but still well below the MCL of 100 µg/L.

Volatile organic compounds (VOCs)

VOCs were not measured this quarter.

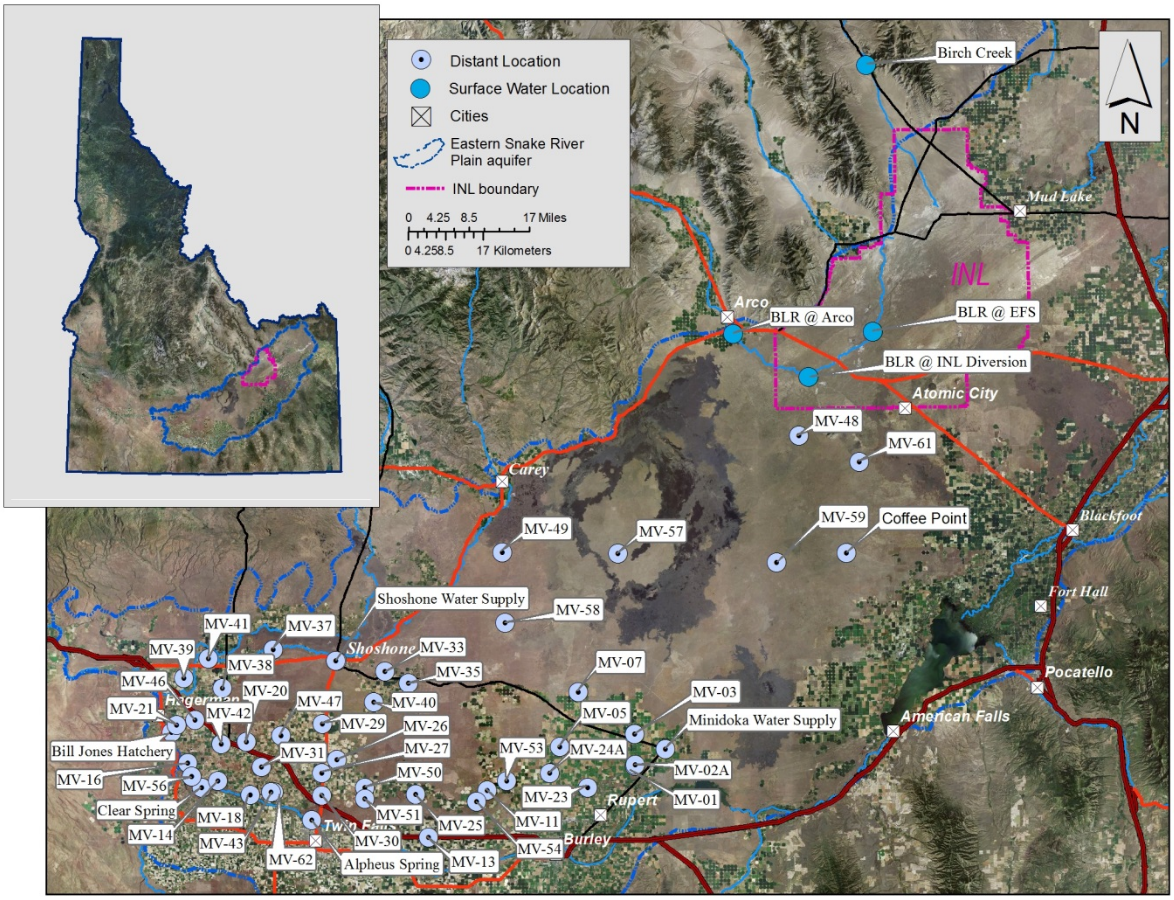

Figure 2. Distant and Surface Water monitoring locations.

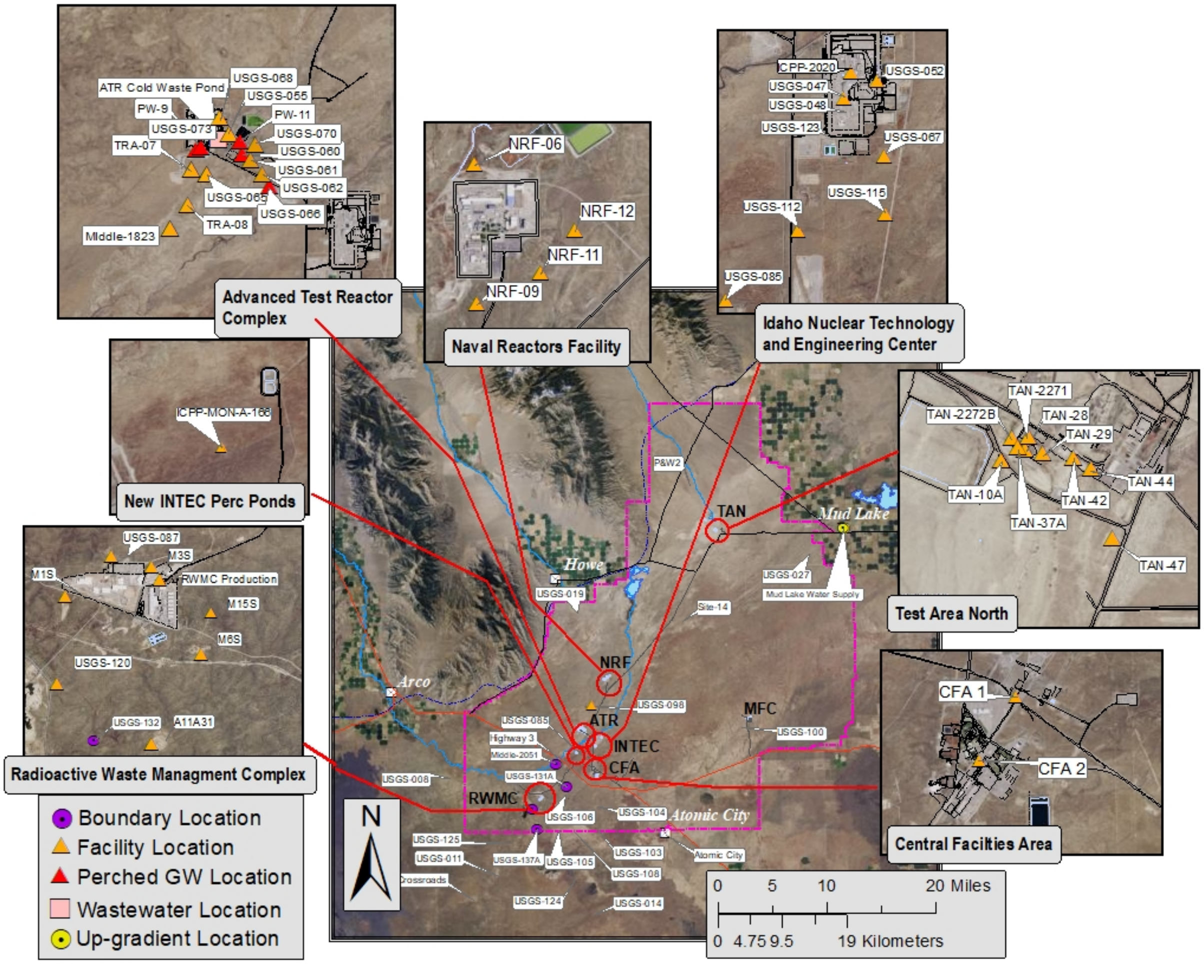

Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), and wastewater monitoring locations.

Table 11. Locations sampled for water, first quarter, 2019.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center:				
USGS-123	03/05/2019	USGS	744.20	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, com. ions, Cr, NO_3+NO_2

ft bgs = feet below ground surface.
*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; U iso. = ^{234}U, ^{235}U, ^{238}U; com. ions = Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, alkalinity; NO_3+NO_2 = nitrate plus nitrite.

Table 12. Constituent background concentration ranges and EPA drinking water standards.

Constituent	Background[1]	MCL or SMCL[2]
Radiological Constituents (pCi/L)		
Gross alpha	0-4[a]	15
Gross beta	0-7[a]	4 mrem/yr
Cesium-137	0	200
Tritium	0-33[a]	20,000
Strontium-90	0	8
Technetium-99	0	900
Uranium-234	0.043-1.36[b]	30 µg/L (total U)
Uranium-235	0-0.025[b]	
Uranium-238	0.021-0.541[b]	
Plutonium-238	0	---
Plutonium-239/240	0	---
Americium-241	0	---
Non-radiological Constituents		
Common Ions (mg/L)		
Alkalinity (as $CaCO_3$)	75 – 144[b]	---
Calcium	22.6 – 40.7[b]	---
Chloride	4.9 – 11.8[b]	250*
Fluoride	0.1 – 0.2[b]	4
Magnesium	10.1 – 15.3[b]	---
Potassium	1.2 – 2.3[b]	---
Sodium	2.6 – 8.3[b]	---
Sulfate	9.6 – 21.4[b]	250*
Trace Metals (µg/L)		
Arsenic	2 – 3[c]	10
Barium	50 – 70[c]	2000
Chromium	<0.012 – 4.0[b]	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 – 0.655[b]	10 for NO_3^-, 1 for NO_2^-
Phosphorous	<0.01 – 0.02[d]	---
Volatile Organic Compounds (µg/L)		
Tetrachloroethene	0	5
Trichloroethene	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	---
1,1-Dichloroethane	0	---

[1] Sources for background ranges are: [a] DEQ data compiled from distant, boundary, and surface water sites in previous years; [b] Bartholomay and Hall, 2016 (DOE/ID-22237); [c] Knobel and others, 1992; [d] Knobel and others, 1999 (DOE/ID-22164). [e] MCL is for total trihalomethanes.

[2] Maximum Contaminant Levels (MCLs) are the highest levels of contaminants legally allowed in public drinking water systems in Idaho. Most wells sampled by DEQ-INL OP are not used for drinking water. A * designates a Secondary MCL (SMCL), which is a guideline recommended by the EPA for constituents that may affect the taste, color, or odor of drinking water.

Table 13. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Idaho Nuclear Technology and Engineering Center:										
USGS-123	3/5/2019	5.1		1.3	6.1		1.1	0.7	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.

Table 14. Tritium concentrations (pCi/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center:				
USGS-123	03/05/19	1720		150

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. Low-level tritium concentrations (pCi/L) in water samples collected during the second and third quarter of 2018 and analyzed using the electrolytic enrichment method 2nd quarter 2019. Sample locations with depths shown are zones in Westbay wells.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Boundary				
USGS-105 (952 ft bgs)	6/27/2018	198		13
USGS-124	4/9/2018	49		9
Distant				
Alpheus Spring	8/8/2018	19		8
Bill Jones Hatchery	8/8/2018	9	U	7
Clear Spring	8/8/2018	13		7
Minidoka Water Supply	8/8/2018	8	U	6
MV-02A	7/17/2018	3	U	7
MV-14	7/18/2018	4	U	7
MV-26	7/17/2018	18		9
MV-31	7/18/2018	7	U	6
MV-42	7/18/2018	2	U	7
Shoshone Water Supply	8/8/2018	6	U	7

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

Table 16. Strontium-90 concentrations (pCi/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center:				
USGS-123	3/5/2019	0.43	U	0.42

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

Table 17. Technetium-99 concentrations (pCi/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Technetium-99 Concentration		Technetium-99 2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center:				
USGS-123	3/5/2019	-0.6	U	1.1

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

Table 18. Uranium isotope concentrations (pCi/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Uranium-234 Concentration		Uranium-234 2 SD	Uranium-235 Concentration		Uranium-235 2 SD	Uranium-238 Concentration		Uranium-238 2 SD
Aquifer Samples										
Facility										
Idaho Nuclear Technology and Engineering Center:										
USGS-123	3/5/2019	1.09		0.28	0.031	U	0.044	0.63		0.19

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

Table 19. Common ion concentrations (mg/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Fluoride		Chloride		Sulfate		Alkalinity†	
Aquifer Samples																	
Facility																	
Idaho Nuclear Technology and Engineering Center:																	
USGS-123	3/5/2019	46		16		16		3.5		na		35.1		26.1		125	

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 $CaCO_3$.
na = not analyzed.

Table 20. Dissolved metals concentrations (µg/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Aquifer Samples																	
Facility																	
Idaho Nuclear Technology and Engineering Center:																	
USGS-123	3/5/2019	na		na		47		na		na		na		na		na	

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.
na = not analyzed.

Table 21. Dissolved nutrient concentrations (mg/L) in water samples, first quarter, 2019.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
Idaho Nuclear Technology and Engineering Center:					
USGS-123	3/5/2019	1.2		na	

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.
na = not analyzed.

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 2019.

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 22**. ^{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 22. Gamma spectroscopy analysis data for milk samples, first quarter, 2019.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Gooding	01/15/2019	1407	121	<MDC
	02/12/2019	1493	126	<MDC
	03/19/2019	1370	118	<MDC
Verification Samples[2]				
Terreton	01/08/2019	1385	85	<MDC
Rupert	01/08/2019	1446	117	<MDC
Idaho Falls	02/05/2019	1333	111	<MDC
Dietrich	02/05/2019	1395	85	<MDC
Howe	03/05/2019	1406	120	<MDC
Rupert	03/05/2019	1474	88	<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

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 first quarter of 2019. 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 first quarter of 2019, DEQ-INL OP submitted 52 QC samples for various radiological and non-radiological analyses (**Table 23**).

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-megohm 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.[3] 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 2019 are presented in **Table 24**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 25**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 26**. Blank analysis results for radiochemical separation analyses for TSP filters collected during 2018 are presented in **Table 27**. Blank sample results for radiological and non-radiological analytes in ground and surface water are presented in **Tables 28**, **29**, and **30**.

[3] The water used by DEQ-INL OP to create blank samples contains measureable 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.

Gross alpha radioactivity was detected just above the MDC in a blank water sample. Because the gross alpha concentration of the one sample associated with this blank—USGS-123—is greater than five times the concentration measured in the blank, it has not been qualified.

All other blank sample results passed acceptance criteria in the first quarter of 2019.

Duplicate Samples

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

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

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

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

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 agreement 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 31**.

All duplicate results passed acceptance criteria in the first quarter of 2019.

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). No spiked water samples were analyzed during the first quarter of 2019.

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 ± 25% when compared to the known irradiated quantity. The irradiation results for first quarter 2019 are presented in **Table 32**. 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 to report in the first quarter of 2019.

Analytical QA/QC Assessment

No issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the first quarter of 2019 which significantly affected data quality. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the first quarter of 2019.

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 of 100% for the first quarter of 2019 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 23**. The overall data completeness (non-qualified results divided by the total number of field sample results expected) of 98.7% is also acceptable.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the first quarter of 2019 the TSP blowers at the Van Buren and Howe sampling stations were replaced. Service reliability for air sampling equipment for the first quarter of 2019 is summarized in **Table 33**.

Conclusion

All data collected for the first quarter of 2019 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 100% and data completeness of 98.7% are acceptable for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 23. Summary of the analyses performed, first quarter, 2019.

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	154	13	0	0	0	ISU-EML
		Gross beta	154	13	0	0	0	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	48	5	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	20	2	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	6	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	1	1	0	0	0	ISU-EML
		Gross beta	1	1	0	0	0	ISU-EML
		Gamma emitters	1	1	0	0	0	ISU-EML
		Tritium	1	1	0	0	0	ISU-EML
		Low-level tritium	12	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	1	0	0	0	IBL
		Common Ions	1	1	0	0	0	IBL
		Nutrients	1	1	0	0	0	IBL
		Volatile Organics	0	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	9	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	67	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	8	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			**519**	**42**	**1**	**9**	**0**	
Total QC analyses performed (blanks, duplicates, and spikes)			**52**					
Ratio of total QC analyses to total sample analyses[3]			**10.0%**					
Percentage of data that are useable[4]			**100%**					

[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.

Table 24. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2019.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
12/27/18	01/03/19	2034	0.0	0.1	0.4	0.5
01/03/19	01/10/19	2034	0.0	0.1	-0.2	0.5
01/10/19	01/17/19	2034	0.0	0.1	-0.1	0.5
01/17/19	01/24/19	2034	-0.1	0.1	0.3	0.5
01/24/19	01/31/19	2034	0.1	0.1	0.2	0.5
01/31/19	02/07/19	2034	0.0	0.1	0.4	0.5
02/07/19	02/14/19	2034	0.0	0.2	-0.1	0.5
02/14/19	02/21/19	2034	-0.1	0.1	0.0	0.5
02/21/19	02/28/19	2034	0.1	0.1	-0.1	0.5
02/28/19	03/07/19	2034	0.0	0.1	-0.1	0.5
03/07/19	03/14/19	2034	0.0	0.1	-0.5	0.5
03/14/19	03/21/19	2034	0.0	0.1	-0.2	0.5
03/21/19	03/28/19	2034	0.0	0.1	0.6	0.5

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

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

Table 25. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2019.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/16/2019	-23	35	62	-26	53	96	-1	6	10

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/16/2019	0	3	5	-1	3	6

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

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

Table 26. Blank analysis results for tritium in water vapor from air samples, first quarter, 2019.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP193ZTR01	4/9/2019	4/10/2019	4/30/2019	0.02	0.09	0.15
OP193ZTR02	4/9/2019	4/10/2019	4/30/2019	0.05	0.11	0.19

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

Table 27. Blank analysis results for 2018 TSP annual radiological 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	-0.22	0.56	1.15	0.41	0.35	0.54	0.07	0.19	0.35	0.00	0.25	0.48
Blank – 2nd analysis				0.00	0.02	0.03	-0.01	0.02	0.03			

Note: Concentrations are expressed in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1] These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar 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 28. Blank analysis results (pCi/L) for radiological constituents in water, first quarter, 2019.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
191W001	3/5/2019	Field	0.9	0.5	0.8	No
Gross Beta						
191W001	3/5/2019	Field	0.9	0.7	1.1	Yes
Cesium-137						
191W001	3/5/2019	Field	-0.3	1.5	2.7	Yes
Tritium (standard method)						
191W002	3/5/2019	Field	50	120	190	Yes
Tritium (low-level method)						
181W427	7/17/2018	Field	22	8	11	Yes

MDC = minimum detectable concentration.

Table 29. Blank analysis results (µg/L) for metals in water, first quarter, 2019.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
191W004	3/5/2019		-	-	<1.0	-	-	-	-	-

Table 30. Blank analysis results (mg/L) for common ions and nutrients in water, first quarter, 2019.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity†	NO_3+NO_2*	Total Phosphorus
191W004,003	3/5/2019		<0.10	<0.10	<0.10	<0.10	-	<0.40	<0.80	<1.0	<0.010	-

† As $CaCO_3$.
* As N.

Table 31. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, first quarter, 2019.

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?
Tritium (low-level method)										
Clear Spring	181W498	13	7	181W504	4	7	106	9	15	Yes

Table 32. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2019.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SJE102	44.0	2.2	40.3	1.4	91.6%	Y
SJE212	44.0	2.2	39.2	1.4	89.1%	Y
SJE207	44.0	2.2	41.6	1.4	94.4%	Y
				Triplicate AVG:	**91.7**	**Y**
SIR634	30.4	1.5	28.5	1.3	93.8%	Y
SJW986	30.4	1.5	28.9	1.4	95.0%	Y
SJE136	30.4	1.5	27.7	1.4	91.2%	Y
				Triplicate AVG:	**93.4%**	**Y**
SJE010	21.9	1.1	18.6	1.4	84.8%	Y
SJE220	21.9	1.1	21.7	1.4	99.2%	Y
SJE204	21.9	1.1	21.3	1.3	97.2%	Y
				Triplicate AVG:	**93.8%**	**Y**

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

Table 33. Air sampling field equipment service reliability (percent operational), first quarter, 2019.

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	92%	100%	100%	NC[1]
Boundary Locations				
Atomic City	100%	100%	100%	100%
Howe	92%	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	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.

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	12/27/18	01/03/19	0.9	0.2	41.4	1.4
	01/03/19	01/10/19	1.1	0.2	41.7	1.4
	01/10/19	01/17/19	0.7	0.2	52.7	1.6
	01/17/19	01/24/19	0.3	0.2	16.8	1.0
	01/24/19	01/31/19	0.7	0.2	34.8	1.3
	01/31/19	02/07/19	1.2	0.3	41.2	1.4
	02/07/19	02/14/19	0.5	0.2	29.7	1.2
	02/14/19	02/21/19	0.8	0.2	31.9	1.2
	02/21/19	02/28/19	0.8	0.2	34.8	1.3
	02/28/19	03/07/19	0.7	0.2	32.9	1.3
	03/07/19	03/14/19	0.6	0.2	21.3	1.1
	03/14/19	03/21/19	0.9	0.2	35.4	1.3
	03/21/19	03/28/19	1.0	0.2	40.0	1.4
Experimental Field Station	12/27/18	01/03/19	0.4	0.2	28.2	1.2
	01/03/19	01/10/19	0.8	0.2	32.5	1.3
	01/10/19	01/17/19	0.9	0.2	51.4	1.6
	01/17/19	01/24/19	0.1	0.2	11.3	0.9
	01/24/19	01/31/19	0.5	0.2	27.0	1.2
	01/31/19	02/07/19	0.4	0.2	27.8	1.2
	02/07/19	02/14/19	0.5	0.2	19.0	1.1
	02/14/19	02/21/19	0.1	0.2	21.3	1.1
	02/21/19	02/28/19	0.6	0.2	25.9	1.2
	02/28/19	03/07/19	0.5	0.2	24.2	1.2
	03/07/19	03/14/19	0.4	0.2	15.0	1.0
	03/14/19	03/21/19	0.7	0.2	26.3	1.2
	03/21/19	03/28/19	0.9	0.2	29.3	1.2
Sand Dunes Tower	12/27/18	01/03/19	0.6	0.2	27.4	1.1
	01/03/19	01/10/19	0.9	0.2	28.2	1.1
	01/10/19	01/17/19	0.8	0.2	45.5	1.4
	01/17/19	01/24/19	0.3	0.2	12.5	0.8
	01/24/19	01/31/19	0.3	0.1	23.8	1.1
	01/31/19	02/07/19	0.6	0.2	28.4	1.1
	02/07/19	02/14/19	0.7	0.3	22.4	1.5
	02/14/19	02/21/19	0.3	0.2	19.7	1.0
	02/21/19	02/28/19	0.6	0.2	23.5	1.1
	02/28/19	03/07/19	0.4	0.2	21.3	1.0
	03/07/19	03/14/19	0.3	0.1	14.1	0.9
	03/14/19	03/21/19	0.4	0.2	22.6	1.0
	03/21/19	03/28/19	3.3	0.5	27.6	1.5

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, first quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/27/18	01/03/19	0.5	0.2	24.5	1.1
	01/03/19	01/10/19	0.6	0.2	23.7	1.1
	01/10/19	01/17/19	0.4	0.4	28.3	1.9
	01/17/19	01/24/19	0.2	0.2	8.7	0.9
	01/24/19	01/31/19	0.4	0.2	20.0	1.0
	01/31/19	02/07/19	0.5	0.2	23.5	1.1
	02/07/19	02/14/19	0.4	0.2	15.8	1.0
	02/14/19	02/21/19	0.2	0.2	16.5	0.9
	02/21/19	02/28/19	0.4	0.2	18.8	1.0
	02/28/19	03/07/19	0.4	0.2	16.9	1.0
	03/07/19	03/14/19	0.4	0.2	12.6	0.9
	03/14/19	03/21/19	0.5	0.2	23.0	1.1
	03/21/19	03/28/19	0.7	0.2	14.2	0.9
Boundary Locations						
Atomic City	12/27/18	01/03/19	0.9	0.2	53.3	1.6
	01/03/19	01/10/19	1.1	0.2	49.4	1.5
	01/10/19	01/17/19	1.3	0.3	68.9	1.8
	01/17/19	01/24/19	0.9	0.2	16.6	1.0
	01/24/19	01/31/19	0.8	0.2	51.0	1.5
	01/31/19	02/07/19	2.0	0.3	45.4	1.4
	02/07/19	02/14/19	0.9	0.2	32.8	1.3
	02/14/19	02/21/19	0.7	0.2	40.1	1.4
	02/21/19	02/28/19	0.9	0.2	35.4	1.3
	02/28/19	03/07/19	0.7	0.2	35.3	1.3
	03/07/19	03/14/19	0.8	0.2	26.5	1.2
	03/14/19	03/21/19	1.0	0.2	43.5	1.4
	03/21/19	03/28/19	1.1	0.2	38.0	1.3
Howe	12/27/18	01/03/19	0.3	0.2	21.3	1.1
	01/03/19	01/10/19	0.6	0.2	23.4	1.1
	01/10/19	01/17/19	0.6	0.2	32.4	1.3
	01/17/19	01/24/19	0.1	0.2	12.4	0.9
	01/24/19	01/31/19	0.3	0.2	20.9	1.1
	01/31/19	02/07/19	0.5	0.2	26.5	1.2
	02/07/19	02/14/19	0.5	0.2	16.9	1.0
	02/14/19	02/21/19	0.2	0.2	15.8	1.0
	02/21/19	02/28/19	0.5	0.2	17.4	1.0
	02/28/19	03/07/19	0.4	0.2	21.2	1.1
	03/07/19	03/14/19	0.4	0.2	12.6	0.9
	03/14/19	03/21/19	0.5	0.2	20.1	1.1
	03/21/19	03/28/19	0.9	0.2	23.5	1.1

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, first quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	12/27/18	01/03/19	0.8	0.2	27.7	1.2
	01/03/19	01/10/19	0.7	0.2	33.0	1.3
	01/10/19	01/17/19	0.9	0.2	51.2	1.6
	01/17/19	01/24/19	0.2	0.2	12.6	0.9
	01/24/19	01/31/19	0.5	0.2	25.5	1.2
	01/31/19	02/07/19	0.5	0.2	29.2	1.2
	02/07/19	02/14/19	0.3	0.2	20.8	1.1
	02/14/19	02/21/19	0.3	0.2	19.9	1.1
	02/21/19	02/28/19	0.6	0.2	22.0	1.1
	02/28/19	03/07/19	0.4	0.2	20.8	1.1
	03/07/19	03/14/19	0.4	0.2	14.3	1.0
	03/14/19	03/21/19	0.6	0.2	19.6	1.0
	03/21/19	03/28/19	0.7	0.2	27.3	1.2
Mud Lake	12/27/18	01/03/19	0.7	0.2	35.0	1.3
	01/03/19	01/10/19	0.9	0.2	43.8	1.4
	01/10/19	01/17/19	1.2	0.3	63.2	1.7
	01/17/19	01/24/19	0.2	0.2	17.1	1.0
	01/24/19	01/31/19	0.6	0.2	30.4	1.2
	01/31/19	02/07/19	1.1	0.3	46.7	1.5
	02/07/19	02/14/19	0.6	0.2	25.2	1.1
	02/14/19	02/21/19	0.4	0.2	27.7	1.2
	02/21/19	02/28/19	0.8	0.2	35.3	1.3
	02/28/19	03/07/19	0.8	0.2	30.3	1.2
	03/07/19	03/14/19	0.5	0.2	21.6	1.1
	03/14/19	03/21/19	0.6	0.2	32.6	1.3
	03/21/19	03/28/19	1.1	0.2	38.3	1.3
Distant Locations						
Craters of the Moon	12/27/18	01/03/19	0.3	0.2	17.2	1.0
	01/03/19	01/10/19	0.4	0.2	20.7	1.0
	01/10/19	01/17/19	0.5	0.2	22.8	1.1
	01/17/19	01/24/19	0.1	0.2	7.4	0.7
	01/24/19	01/31/19	0.5	0.2	14.7	0.9
	01/31/19	02/07/19	0.4	0.2	16.4	0.9
	02/07/19	02/14/19	NS[1]	NS[1]	NS[1]	NS[1]
	02/07/19	02/21/19	0.2	0.1	10.7	0.5
	02/21/19	02/28/19	NS[1]	NS[1]	NS[1]	NS[1]
	02/21/19	03/07/19	0.3	0.1	11.6	0.6
	03/07/19	03/14/19	0.5	0.2	9.2	0.8
	03/14/19	03/21/19	0.4	0.2	19.2	1.0
	03/21/19	03/28/19	0.4	0.2	21.0	1.0

[1]NS = No sample – Filters could not be exchanged due to road closure caused by weather, so filters were deployed for two weeks.

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, first quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	12/27/18	01/03/19	0.9	0.2	41.0	1.4
	01/03/19	01/10/19	1.3	0.3	42.9	1.4
	01/10/19	01/17/19	1.6	0.3	61.0	1.7
	01/17/19	01/24/19	0.2	0.2	13.1	0.9
	01/24/19	01/31/19	1.2	0.2	33.5	1.3
	01/31/19	02/07/19	1.1	0.3	37.7	1.3
	02/07/19	02/14/19	0.8	0.2	26.3	1.2
	02/14/19	02/21/19	0.6	0.2	26.6	1.2
	02/21/19	02/28/19	1.2	0.3	37.9	1.4
	02/28/19	03/07/19	1.0	0.2	29.7	1.2
	03/07/19	03/14/19	0.9	0.2	24.6	1.2
	03/14/19	03/21/19	1.6	0.3	36.9	1.3
	03/21/19	03/28/19	1.3	0.3	37.6	1.3
Idaho Falls - HVP 4304	12/27/18	01/03/19	0.9	0.2	50.5	1.5
	01/03/19	01/10/19	1.2	0.2	40.6	1.4
	01/10/19	01/17/19	1.1	0.3	58.9	1.6
	01/17/19	01/24/19	0.2	0.2	12.5	0.9
	01/24/19	01/31/19	1.0	0.2	38.9	1.4
	01/31/19	02/07/19	1.0	0.3	39.6	1.4
	02/07/19	02/14/19	0.8	0.2	26.8	1.2
	02/14/19	02/21/19	0.6	0.2	29.2	1.2
	02/21/19	02/28/19	1.0	0.2	33.2	1.3
	02/28/19	03/07/19	0.7	0.2	31.5	1.3
	03/07/19	03/14/19	0.6	0.2	25.0	1.2
	03/14/19	03/21/19	1.0	0.2	31.7	1.2
	03/21/19	03/28/19	1.5	0.3	36.3	1.3
Idaho Falls - HVP 4304[DP]	12/27/18	01/03/19	0.9	0.2	39.4	1.4
	01/03/19	01/10/19	1.1	0.2	41.3	1.4
	01/10/19	01/17/19	0.8	0.2	47.2	1.5
	01/17/19	01/24/19	0.2	0.2	11.2	0.8
	01/24/19	01/31/19	0.7	0.2	31.9	1.3
	01/31/19	02/07/19	0.9	0.2	35.7	1.3
	02/07/19	02/14/19	0.8	0.2	23.8	1.1
	02/14/19	02/21/19	0.4	0.2	28.3	1.2
	02/21/19	02/28/19	0.9	0.2	29.2	1.2
	02/28/19	03/07/19	0.7	0.2	29.6	1.2
	03/07/19	03/14/19	0.5	0.2	22.2	1.1
	03/14/19	03/21/19	0.9	0.2	33.0	1.3
	03/21/19	03/28/19	1.5	0.3	33.6	1.3

HVP 4304[DP] – This is a duplicate sampler.
[1] Operated by Shoshone Bannock-Tribes.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2019.

Sample Location	Net Corrected Exposure Rate (μR/hr)[1]	± 2 SD (μR/hr)
Arco	10.4	2.7
Craters of the Moon	8.0	2.1
Rest Area	11.0	1.4
Van Buren Avenue	14.0	1.3
Experimental Field Station	14.9, 16.3	-
Main Gate	9.9	2.2
Atomic City	7.9	3.3
Taber	11.4	1.9
Blackfoot	9.0	2.4
Ft. Hall	10.0	1.9
Idaho Falls	8.5,11.6	-
Mud Lake/ Terreton	15.1	1.9
Monteview	9.4, 10.5	-
Sand Dunes	11.2, 13.4	-
Howe Met. Tower	12.7	0.8
MP282 -20	10.2	2.6
MP280 -20	9.9	3.6
MP278 -20	10.4	1.1
MP276 -20	9.5	3.0
MP274 -20	8.3	2.2
MP272 -20	9.0, 11.3	-
MP270 -20	7.8,8.0	-
MP268 -20	8.2, 8.6	-
MP266 -20	9.0	2.1
MP264 -20	12.4	1.8
MP270 -20/26	10.6	0.8
MP268 -20/26	9.7	2.9
MP266 -20/26	9.9	0.5
MP263 -20/26	10.8	2.2
MP261 -20/26	10.0	2.0
MP259 -20/26	8.3	2.7
MP256 -20/26	7.2, 8.0	-
MFC (EBR II)	11.5	3.0
EBR I	12.8	1.8
RWMC	10.1	1.6
CFA	11.9, 12.2	-
CITRC (PBF)	11.5	1.0
INTEC	15.2	0.8
ATR (TRA)	11.9	3.3
NRF	11.1, 11.9	-
TAN/SMC	9.3, 9.3	-
Mud Lake Bank of Commerce	14.5	2.9
MP43-33	10.4	0.4
MP41-33	12.9	1.9
MP39-33	10.2	2.7
MP37-33	10.6	2.8
MP35-33	10.5	0.9
MP33-33	10.9, 12.4	-
MP31-33	9.0	1.8
MP29-33	11.8	3.4

Table B.1 cont. Results for all electret ionization chamber (EIC) locations, first quarter, 2019.

Sample Location	Net Corrected Exposure Rate (μR/hr)[1]	± 2 SD (μR/hr)
MP27-33	13.3	2.2
MP25-33	10.4	2.9
MP23-33	9.2, 10.0	-
MP21-33	8.0	0.9
MP19-33	10.5	1.7
MP14-33	8.0, 8.5	-
MP11-33	11.8	2.6
MP06-33	8.1	2.2
MP03-33	6.8, 7.0	-
Base of Howe	13.3, 14.2	-
Rover	13.5, 13.8	-
Hamer	11.4, 12.1	-
Sugar City	13.1,14.3	-
Roberts	10.1,13.0	-
Big Southern Butte	16.2, 16.8	-
T4 North	20.9	0.6
T4 South	20.4	3.1

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