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
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 $1/1000^{th}$ 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
NOAA - National Oceanic and Atmospheric Administration
NRF - Naval Reactors Facility
PBF - Power Burst Facility
pCi/g - picocuries per gram
pCi/L - picocuries per liter
pCi/m^3 - picocuries per cubic meter
QAPP - Quality Assurance Program Plan
QA/QC - Quality Assurance/Quality Control
RCRA - Resource Conservation and Recovery Act
RPD - relative percent difference
RTC - Reactor Technology Complex
RWMC - Radioactive Waste Management Complex
SD - Sample standard deviation
SMC - Specific Manufacturing Capability
SMCL - secondary maximum contaminant level
TAN - Test Area North
TDS - total dissolved solids
TMI - Three Mile Island
TRA - Test Reactor Area
TSP - total suspended particulate
TSS - total suspended solids
USGS - U.S. Geological Survey
VOC - volatile organic compound
WLAP - Wastewater Land Application Permit

Introduction

The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program (DEQ-INL OP) conducts an Environmental Surveillance Program (ESP) at locations on the INL, near the boundaries of the INL, and at distant locations to the INL in accordance with accepted monitoring procedures and management practices. This program is designed to provide the people of the state of Idaho with independently evaluated information about the impacts of the Department of Energy's (DOE) activities in Idaho.

The primary objective for DEQ-INL OP's ESP is to maintain an independent environmental monitoring and verification program designed to verify and supplement DOE's environmental data and programs. This program also provides the citizens of Idaho with information on current and proposed DOE programs that has been independently evaluated to enable them to reach informed conclusions about DOE activities in Idaho and potential impacts to public health and the environment.

Results of the ESP are published using two distinct reporting formats: quarterly data reports and an annual ESP report. The annual ESP report is designed for a broad audience and summarizes the results of the ESP for the previous four quarters. The annual report's primary emphasis is to focus on trends, ascertain the impacts of DOE operations on the environment, and confirm the validity of DOE monitoring programs. This quarterly report is designed to document the results of the ESP on a quarterly basis and provide detailed data. It is organized according to the media sampled and also provides a quality assurance assessment.

Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the third quarter, 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. 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**. With the exception of a couple of weeks where lower than average sample volumes resulted in higher than average concentrations, all results were within expected historical ranges.

Due to elevated levels of particulate matter in the air during the INL Sheep Fire event, some locations on and near the site required filters to be changed in advance of the typical one week sampling schedule in order to maintain sampler function. Because of increased sample change frequency, some samples taken during the Sheep Fire had much lower than average sample volumes. Typically results are rejected if there is insufficient sample volume, but all results taken during the Sheep Fire event are presented in this report, with the exception of one sample from Rest area and one sample from Fort Hall where equipment failure was involved. Table 2a is included as an addition to this quarter's report and shows the results of gross alpha and beta analysis of TSP filters during the fire. There was not an appreciable difference in gross alpha or beta measurements during the fire when compared to the rest of the quarter or historical data.

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 third quarter of 2019 for TSP filters are presented in **Table 3**. Beryllium-7, a naturally occurring, cosmogenic radionuclide was seen at all locations. Cesium-137, a man-made radionuclide was seen above MDC at the Experimental Field Station, but was well below INL OP action level of $1.9x10^{-3}$ pCi/m^3.

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 third 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. Five individual samples and one average (Experimental Field Station) had tritium concentrations above the MDC, but all samplers were well below the DEQ-INL OP action level of 150 pCi/m^3. Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the third quarter of 2019. 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 third 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**.

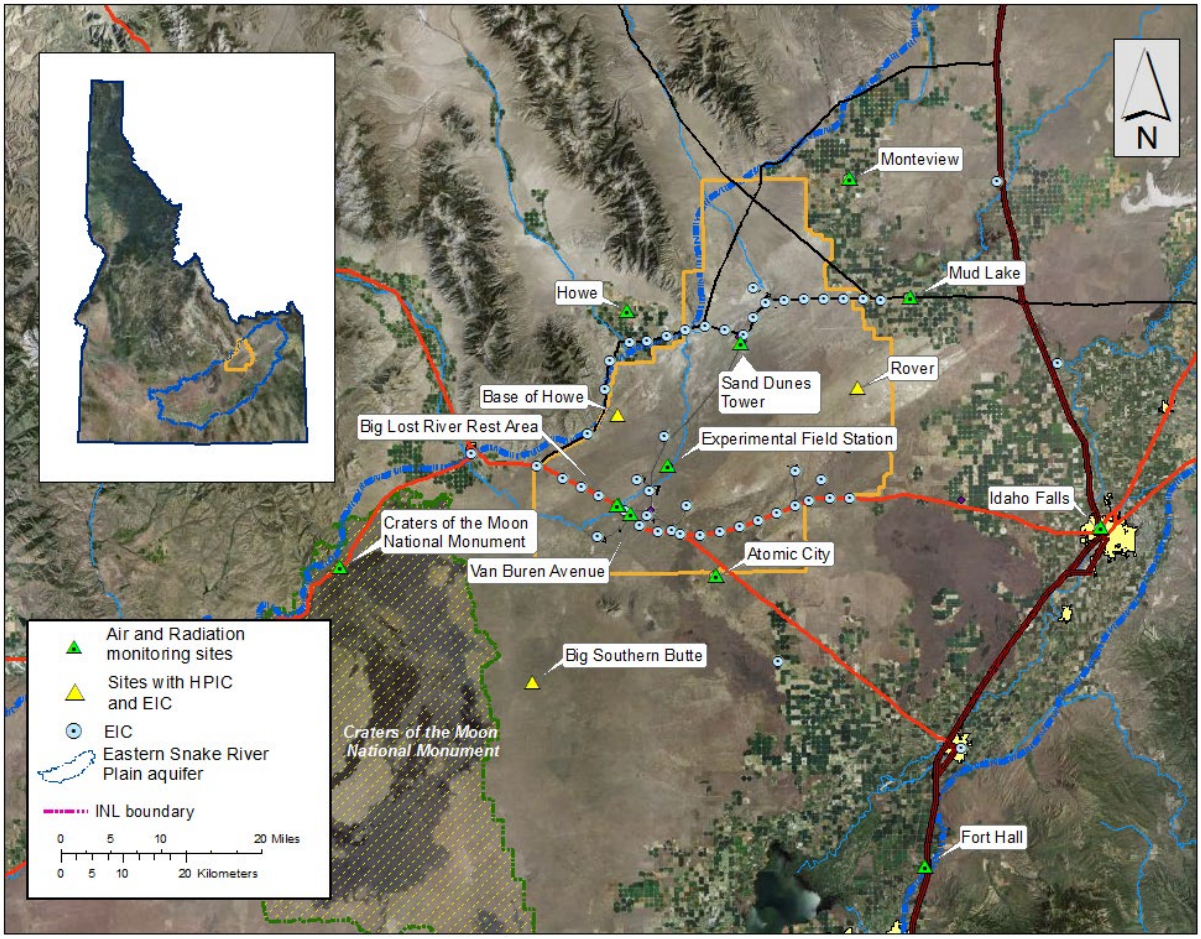

Figure 1. Air and radiation monitoring locations.

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, third quarter, 2019.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.6	-	3.9	19.6	-	49.5
Experimental Field Station	0.6	-	3.3	22.3	-	37.7
Sand Dunes Tower	0.3	-	1.1	20.0	-	29.5
Van Buren Avenue[3]	1.3	-	3.1	35.5	-	77.4
Boundary Locations						
Atomic City	0.7	-	2.4	30.9	-	53.0
Howe	0.3	-	1.1	17.0	-	30.5
Monteview	0.5	-	1.4	19.8	-	33.0
Mud Lake	0.6	-	2.0	26.5	-	44.2
Distant Locations						
Craters of the Moon	0.4	-	1.3	18.3	-	36.7
Fort Hall[1,2]	1.1	-	2.0	27.7	-	52.1
Idaho Falls	0.6	-	1.7	23.3	-	43.1

[1]Operated by Shoshone-Bannock Tribes.
[2]The highest gross alpha and gross beta readings occurred during a week that the station experienced a power outage, resulting in low sample volume, affecting the calculated concentration.
[3]The highest gross beta reading occurred during a week that the sampler shut down due to heavy filter loading, resulting in a low sample volume, affecting the calculated concentration.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 2a. Gross alpha and beta concentrations during Sheep Fire

Station Location	Sampling Period	Concentration	
		Gross Alpha	Gross Beta
On-Site Locations			
Big Lost River Rest Area	7/18-7/23	1.9	39.4
	7/23-7/24	3.9	44.6
	7/24-7/25	2.0	19.6
	7/25-8/1	1.5	41.5
Experimental Field Station[2]	7/18-7/24	2.7	27.8
	7/29-8/1	1.9	33.6
Sand Dunes Tower	7/18-7/25	0.9	21.7
	7/25-8/1	0.6	23.8
Van Buren Avenue	7/18-7/23	3.1	54.6
	7/23-7/24	R[3]	R[3]
	7/24-7/25	2.4	77.4
	7/25-8/1	2.3	63.4
Boundary Locations			
Atomic City	7/18-7/24	2.4	36.3
	7/24-7/25	0.7	36.2
	7/25-8/1	1.2	39.8
Howe	7/18-7/25	1.1	22.2
	7/25-8/1	0.7	22.1
Monteview	7/18-7/25	1.3	26.7
	7/25-8/1	0.9	28.2
Mud Lake	7/18-7/25	1.8	28.5
	7/25-8/1	1.1	33.2
Distant Locations			
Craters of the Moon	7/18-7/25	1.1	24.7
	7/25-8/1	0.8	23.9
Fort Hall[1]	7/18-7/25	1.7	35.6
	7/25-8/1	R[3]	R[3]
Idaho Falls	7/18-7/25	1.5	34.3
	7/25-8/1	1.1	38.9

[1]Operated by Shoshone-Bannock Tribes.
[2]Sampler was not accessible to restart until 7/29.
[3]Power outage resulted in insufficient sample volume for analysis.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, third 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	172.1	9.2	<MDC[2]	
Experimental Field Station	113.8	6.0	0.13[3]	0.07
Sand Dunes Tower	109.9	6.0	<MDC	
Van Buren Avenue	237.0	12.2	<MDC	
Boundary Locations				
Atomic City	176.3	9.1	<MDC	
Howe	109.4	5.9	<MDC	
Monteview	113.4	6.0	<MDC	
Mud Lake	132.5	6.9	<MDC	
Distant Locations				
Craters of the Moon	114.4	6.0	<MDC	
Fort Hall[1]	189.7	9.7	<MDC	
Idaho Falls	178.3	9.6	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
[3] ^{137}Cs was detected above MDC.
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, third quarter, 2019.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.36	0.43	0.71
Experimental Field Station	0.75	0.42	0.65
Sand Dunes Tower	0.14	0.36	0.60
Van Buren Avenue	0.44	0.40	0.65
Boundary Locations			
Atomic City	0.15	0.39	0.66
Howe	0.20	0.51	0.85
Mud Lake	0.10	0.50	0.84
Monteview	0.43	0.56	0.92
Distant Locations			
Craters of the Moon	0.12	0.30	0.51
Fort Hall[1]	0.06	0.24	0.40
Idaho Falls	0.09	0.45	0.76

[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 Cesium-137 concentrations from precipitation, third quarter, 2019.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	0	120	200	1.6	1.6	2.6
Boundary Locations						
Atomic City[1]	30	120	200	-	-	-
Howe	-40	120	200	1.4	1.2	1.9
Monteview	-10	120	200	1.2	1.3	2.1
Mud Lake	-50	120	200	0.2	1.9	3.3
Distant Locations						
Idaho Falls	-30	120	200	-0.7	1.5	2.6

Note: Concentrations are reported in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]Insufficient sample for gamma analysis.

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the third 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) or EcoGamma dual Geiger–Müller gamma radiation monitor. (**Table 6**).

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 and EcoGammas are instruments capable of real-time measurements, and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the HPICs and EcoGammas 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 7** lists the average radiation exposure rates measured by the HPICs for third quarter 2019. **Table 8** lists the EIC monitoring results for third quarter 2019. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

During quarter 3, the Sheep Fire at the INL burned through the environmental radiation station at Rover. This caused damage to the EcoGamma located there. Due to safety limitations DEQ-INL OP staff could not access the station to make repairs until approximately a week after the fire. As such, there is no data for this site between 7/22/19 and 7/29/19.

Table 7a is included in this quarter's report showing the average gamma exposure rate as measured by the HPIC/EcoGamma network for the week following the Sheep Fire (7/22-7/29). There was no appreciable difference seen during this week when compared to the quarterly average or historical measurements.

Table 6. 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 7. Average gamma exposure rates, third quarter, 2019, from HPIC* network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	16.1	1.4
Big Lost River Rest Area	12.5	3.8
Rover	17.3	1.5
[1]Sand Dunes Tower	16.4	1.6
Boundary Locations		
Atomic City	14.3	1.7
Big Southern Butte	15.1	2.4
Howe Met Tower	13.3	0.7
Monteview	13.3	1.6
Mud Lake / Terreton	15.1	1.9
Distant Locations		
Fort Hall	12.6	2.9
Idaho Falls	9.4	4.3

[1] HPIC was non-functional 7/1-8/25 and was replaced with an EcoGamma 8/26.
*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 7a. Average gamma exposure rates, week of Sheep Fire from HPIC* network.

Station Location	Exposure Rate (µR/hr)	
	Weekly Average	± 2 SD
On-site Locations		
Base of Howe	16.0	0.6
Big Lost River Rest Area	11.8	1.7
[2]Rover	-	-
[1]Sand Dunes Tower	-	-
Boundary Locations		
Atomic City	13.8	1.0
Big Southern Butte	15.5	4.9
Howe Met Tower	13.1	0.2
Monteview	12.9	1.2
Mud Lake / Terreton	14.4	0.3
Distant Locations		
[3]Fort Hall	-	-
Idaho Falls	7.4	2.4

[1]HPIC was non-functional 7/1-8/25 and was replaced with an EcoGamma 8/26.
[2]EcoGamma at Rover was damaged by the fire and non-functional for this week.
[3]Fort Hall HPIC was non-functional 7/18-7/29.
*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 8. Electret ionization chamber (EIC) cumulative average exposure rates, third quarter, 2019.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	13.2, 13.4	-
Big Lost River Rest Area	14.8	1.8
Experimental Field Station	12.7, 13.5	-
Rover	17.9, 18.0	-
Sand Dunes Tower	14.1	3.0
Van Buren Avenue	15.0, 17.0	-
Boundary Locations		
Atomic City	13.0, 16.2	-
Big Southern Butte	9.5, 11.0	-
Howe Met Tower	12.2	2.1
Monteview	12.5, 13.6	-
Mud Lake/Terreton	13.3	3.2
Distant Locations		
Craters of the Moon	12.5	1.9
Fort Hall	12.5, 14.1	-
Idaho Falls	12.3	2.6

[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 third 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

[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 third and fourth quarters. Samples for common ions, nitrate-plus-nitrate, and other constituents are collected at these locations during the third quarter.

phosphorous, and/or volatile organic compounds (VOCs) based on past and present INL operations or a history of elevated concentrations. If unexpected levels of radioactivity are detected in gross measurements, additional samples will be collected and analyzed for specific radionuclides.

During the third quarter of 2019, DEQ-INL OP sampled groundwater from the aquifer at 12 distant locations, three spring locations, and one upgradient location. **Table 9** lists the sample date, co-sampler, well depth, and analyses requested for the locations sampled this quarter. Analytical results are reported in **Tables 11 through 16** and summarized below. The results of low-level tritium analyses for 23 samples collected in previous quarters are reported in **Table 13** and discussed below.

Table 10 shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary MCL. Background concentrations depend on local geology, and the concentrations of constituents at sites not influenced by INL activities may on occasion be higher than the given background ranges due to local factors and natural variability.

Gross alpha and gross beta radioactivity

Gross alpha and gross beta analyses are used to screen for unexpectedly high levels of radioactivity in samples. DEQ-INL OP has determined from past sampling that background concentration ranges for gross alpha and gross beta radioactivity in the ESRP aquifer are approximately 0-5.6 pCi/L and 0-8.6 pCi/L, respectively. Occasional measurements of concentrations above these background ranges in uncontaminated samples are statistically probable due to uncertainties inherent in measuring low levels of radioactivity. Additionally, some samples will have levels of radioactivity slightly higher than background ranges due to higher-than-average concentrations of naturally occurring uranium, thorium, or potassium-40.

Gross alpha and beta radioactivity were detected at low levels in most samples. Gross alpha radioactivity was measured at concentrations within the known background range at all distant locations, with the exception of MV-13, where a slightly elevated value of 5.8 pCi/L was measured. The gross beta concentration at Alpheus Spring (9.6 ± 1.2 pCi/L) was slightly above the natural background range typically observed in the aquifer but consistent with previous measurements at this location. All other detectable concentrations in groundwater were consistent with historical trends.

Manmade gamma-emitting radionuclides

No manmade gamma-emitting radionuclides were detected at the locations sampled this quarter. Results for cesium-137 (^{137}Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 11**.

Tritium

Tritium was measured at all locations sampled this quarter (**Table 12**). Using the standard analytical method, which typically has an MDC of 110 to 190 pCi/L, tritium was not detected at any of the locations sampled this quarter.

Samples from this quarter requiring low-level tritium analysis have not yet been analyzed by that method due to a sample backlog. Two low-level tritium samples from 2017, five from 2018, and sixteen from 2019 were analyzed in the third quarter of 2019, and the results are reported in **Table 13**. Five samples are from boundary wells, ten are from facility wells, and the remaining eight are from distant, upgradient, surface, and waste water locations. All but five reported concentrations are within the background range (< 33 pCi/L) and all outside this range are consistent with past results. A backlog of 41 samples to be analyzed for low-level tritium remains.

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

No locations were sampled for uranium isotopes, plutonium isotopes, ^{90}Sr, ^{99}Tc, or ^{241}Am this quarter.

Common ions, trace metals, and nutrients

All locations were sampled for common ions (calcium, magnesium, sodium, potassium, chloride, sulfate, and alkalinity), chromium, and dissolved nutrients (nitrate-plus-nitrite). Only six locations were sampled for phosphorous during the quarter (**Tables 14, 15, and 16**).

Most results were consistent with past results with some elevated compared to background concentrations. MV-05 and MV-53 had elevated concentrations of sodium (51 mg/L and 52 mg/L), chloride (69.1 mg/L and 84 mg/L), and sulfate (72.7 mg/L, 85.3 mg/L), as well as nitrate + nitrite (3.8 mg/L and 5.9 mg/L). All other concentrations were consistent with past observations and trends with most within natural background ranges.

Volatile organic compounds (VOCs)

No locations were sampled for VOCs this quarter.

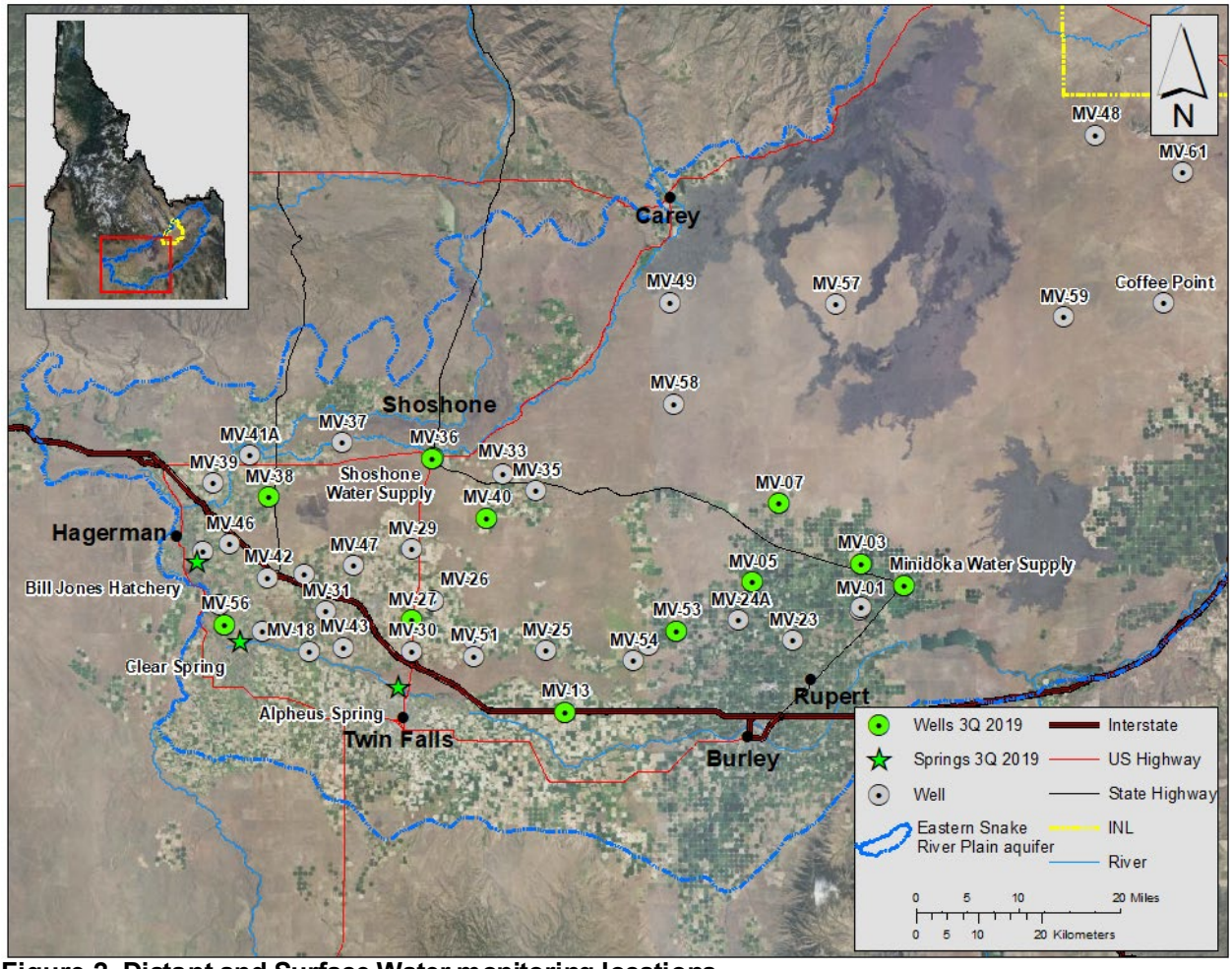

Figure 2. Distant and Surface Water monitoring locations.

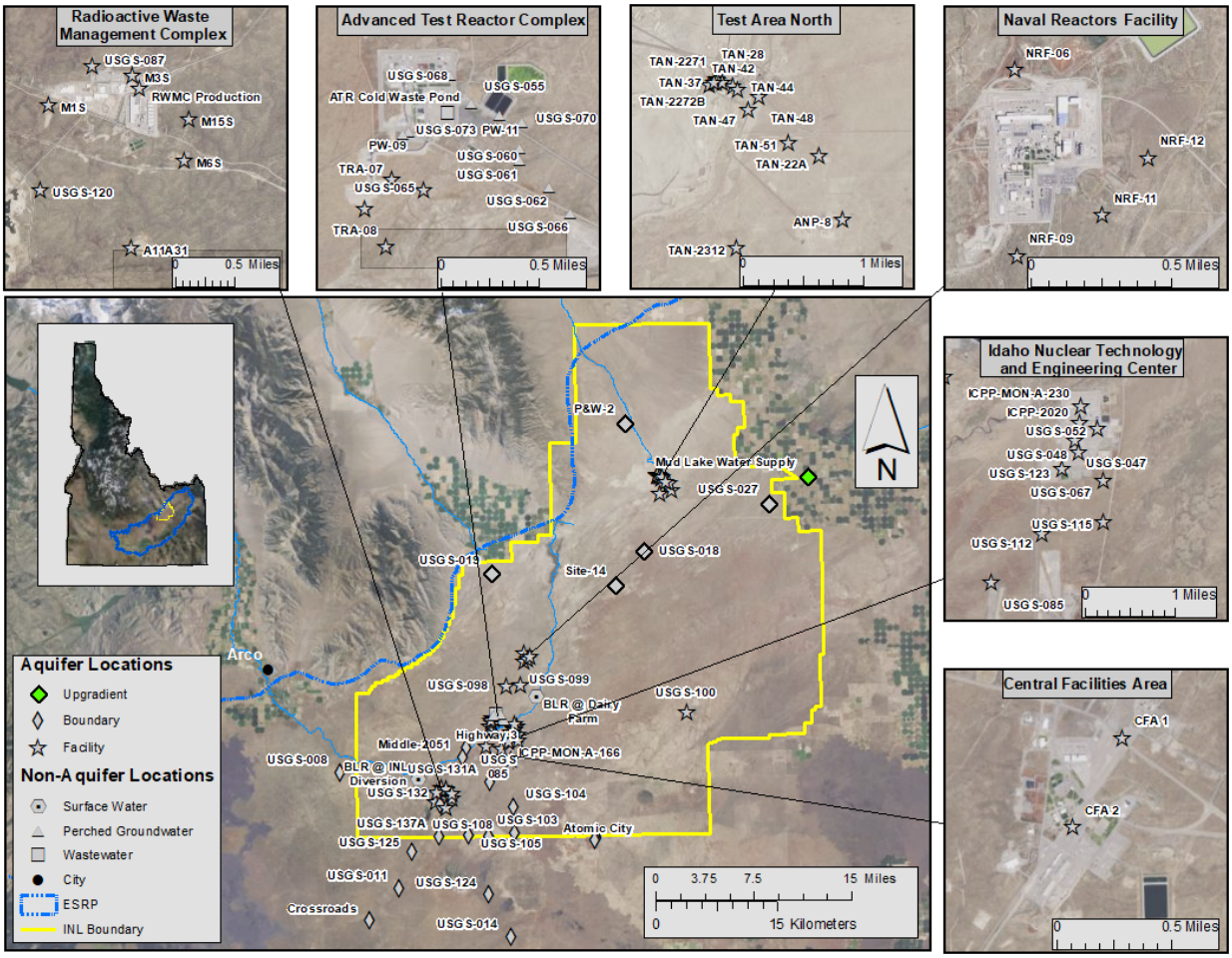

Figure 3. Up-gradient, facility, boundary, perched groundwater (GW) and wastewater monitoring locations.

Table 9. Locations sampled for water, third quarter, 2019.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	8/7/2019	None	330	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P
Distant				
Alpheus Spring	8/6/2019	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P
Bill Jones Hatchery	8/6/2019	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P
Clear Spring	8/6/2019	None	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P
Minidoka Water Supply	8/6/2019	None	282	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P
MV-03	7/16/2019	None	296	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-05	7/16/2019	None	388	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-07	7/16/2019	None	401	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-13	7/17/2019	None	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-27	7/16/2019	None	480	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-36	7/16/2019	None	355	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-38	7/17/2019	None	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-40	7/17/2019	None	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-53	7/16/2019	None	350	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
MV-56	7/17/2019	None	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Shoshone Water Supply	8/6/2019	None	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2, P

ft bgs = feet below ground surface.
*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; ^{3}H = tritium; 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; P = phosphorous.
n/a = well depth not available.

Table 10. Constituent background concentration ranges and EPA drinking water standards.

Constituent	Background[1]	MCL or SMCL[2]
Radiological Constituents (pCi/L)		
Gross alpha	0-5.6[a]	15
Gross beta	0-8.6[a]	4 mrem/yr
Cesium-137	0	200
Tritium	0-33[a]	20,000
Strontium-90	0	8
Technetium-99	0	900
Uranium-234	0.043-1.9[b]	30 µg/L (total U)
Uranium-235	0-0.048[b]	
Uranium-238	0.021-0.719[b]	
Plutonium-238	0	---
Plutonium-239/240	0	---
Americium-241	0	---
Non-radiological Constituents		
Common Ions (mg/L)		
Alkalinity (as $CaCO_3$)	91-261[a]	---
Calcium	23 – 71[a]	---
Chloride	4.9 – 66.6[a]	250*
Fluoride	0.1 – 1.50[a]	4
Magnesium	10.1 – 27.4[a]	---
Potassium	1.2 – 5.8[a]	---
Sodium	2.6 – 27.0[a]	---
Sulfate	9.6 – 40.4[a]	250*
Trace Metals (µg/L)		
Arsenic	2 – 3[c]	10
Barium	50 – 70[c]	2000
Chromium	<0.012 – 45[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 – 3.59[b]	10 for NO_3^-, 1 for NO_2^-
Phosphorous	<0.01 – 0.02[d]	---
Volatile Organic Compounds (µg/L)		
Tetrachloroethene (PCE)	0	5
Trichloroethene (TCE)	0	5
1,1-Dichloroethene	0	7
cis-1,2-dichloroethene	0	70
trans-1,2-dichloroethene	0	100
Vinyl chloride	0	2
Carbon tetrachloride	0	5
Chloroform	0	80[e]
Chloromethane	0	---
Methylene Chloride	0	5
Methyl Ethyl Ketone	0	---
1,1-Dichloroethane	0	---

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

Table 11. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) for water samples, third quarter, 2019.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Upgradient										
Mud Lake Water Supply	8/7/2019	0.9	U	0.7	4.8		0.8	0.6	U	1.4
Distant										
Alpheus Spring	8/6/2019	3.1		1.5	9.6		1.2	1.4	U	1.3
Bill Jones Hatchery	8/6/2019	1.7		1.0	4.4		0.9	-1.3	U	1.5
Clear Spring	8/6/2019	2.0		1.1	5.1		1.0	1.1	U	1.5
Minidoka Water Supply	8/6/2019	1.5	U	1.1	4.4		1.0	1.6	U	1.8
MV-03	7/16/2019	2.0		1.2	3.4		1.0	1.2	U	2.2
MV-05	7/16/2019	0.2	U	0.3	0.0	U	0.6	0.4	U	1.4
MV-07	7/16/2019	0.9	U	1.0	2.8		1.0	-0.5	U	1.7
MV-13	7/17/2019	5.8		2.0	7.8		1.3	0.8	U	1.4
MV-27	7/16/2019	3.3		1.7	6.2		1.2	-0.7	U	1.5
MV-36	7/16/2019	3.3		1.3	4.3		1.0	0.1	U	1.3
MV-38	7/17/2019	0.4	[1]J-	0.3	2.1		0.7	-0.2	U	1.5
MV-40	7/17/2019	1.5	U	1.1	3.8		1.0	0.4	U	1.8
MV-53	7/16/2019	2.4	U	1.8	7.1		1.8	1.3	U	1.3
MV-56	7/17/2019	1.2	U	1.1	3.4		1.0	0.2	U	1.6
Shoshone Water Supply	8/6/2019	3.3		1.2	5.0		1.0	0.5	U	1.5

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*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.
[1]Result >2 SD but <3 SD, so it is considered an estimate.

Table 12. Tritium concentrations (pCi/L) for water samples, third quarter, 2019.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	8/7/2019	0	U	90
Distant				
Alpheus Spring	8/6/2019	20	U	80
Bill Jones Hatchery	8/6/2019	20	U	80
Clear Spring	8/6/2019	0	U	80
Minidoka Water Supply	8/6/2019	40	U	90
MV-03	7/16/2019	-50	U	120
MV-05	7/16/2019	-110	U	110
MV-07	7/16/2019	-90	U	120
MV-13	7/17/2019	-90	U	120
MV-27	7/16/2019	-50	U	120
MV-36	7/16/2019	40	U	80
MV-38	7/17/2019	60	U	90
MV-40	7/17/2019	40	U	80
MV-53	7/16/2019	30	U	80
MV-56	7/17/2019	-30	U	80
Shoshone Water Supply	8/6/2019	50	U	100

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. Low-level tritium concentrations (pCi/L) in water samples collected during 2017-2018 and analyzed using the electrolytic enrichment method third quarter of 2019.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Upgradient				
P&W-2	4/8/2019	4	U	7
USGS-018	4/8/2019	4	U	7
USGS-019	4/8/2019	1	U	6
USGS-027	4/8/2019	-2	U	6
Facility				
A11A31	5/14/2019	102		11
ICPP-MON-A-166	4/17/2019	55		8
M6S	5/13/2019	1	U	6
NRF-09	5/15/2019	24		7
NRF-11	5/15/2019	26		7
NRF-12	5/9/2017	18		8
NRF-12	5/15/2019	16		7
USGS-066	10/10/2018	96		10
USGS-100	4/15/2019	10	J-	7
USGS-120	10/9/2018	32		7
Boundary				
Crossroads	4/16/2019	9	U	7
Highway 3	10/12/2017	70		8
USGS-008	4/16/2019	17		7
USGS-011	4/18/2019	22		7
USGS-125	10/9/2018	57		9
Distant				
MV-33	7/17/2018	3	U	6
Surface Water				
BLR @ Dairy Farm	4/17/2019	19		6
BLR @ INL Diversion	4/17/2019	23		7
Waste Water				
TRA Cold Waste Pond	10/11/2018	16		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 bgs = feet below ground surface

Table 14. Common ion concentrations (mg/L) in water samples, third quarter, 2019.

Sample Location	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity†
Aquifer Samples									
Upgradient									
Mud Lake Water Supply	8/7/2019	8.8	2.8	30	4.8	-	4.92	8.38	91.7
Distant									
Alpheus Spring	8/6/2019	56	20	33	6.3	-	42.4	58.7	182
Bill Jones Hatchery	8/6/2019	30	15	16	3.4	-	10.8	25.6	134
Clear Spring	8/6/2019	43	18	24	4.0	-	32.2	46.8	149
Minidoka Water Supply	8/6/2019	48	16	21	3.5	-	35.0	45.7	142
MV-03	7/16/2019	37	14	20	3.3	-	25.4	33.9	130
MV-05	7/16/2019	59	25	51	5.7	-	69.1	84.0	187
MV-07	7/16/2019	33	14	16	3.3	-	14.8	32.5	126
MV-13	7/17/2019	51	20	35	6.2	-	33.6	57.0	190
MV-27	7/16/2019	57	22	35	5.0	-	51.3	66.9	175
MV-36	7/16/2019	47	15	14	2.8	-	8.08	20.7	181
MV-38	7/17/2019	39	14	15	3.0	-	11.4	21.6	153
MV-40	7/17/2019	30	15	16	3.5	-	12.0	26.3	136
MV-53	7/16/2019	70	30	52	6.8	-	72.7	85.3	224
MV-56	7/17/2019	36	16	20	3.6	-	22.5	37.8	137
Shoshone Water Supply	8/6/2019	44	14	14	2.9	-	7.06	18.3	171

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 $CaCO_3$.
"-" = not analyzed.

Table 15. Dissolved metals concentrations (µg/L) in water samples, third quarter, 2019.

Sample Location	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
Aquifer Samples									
Upgradient									
Mud Lake Water Supply	8/7/2019	-	-	<1 U	-	-	-	-	-
Distant									
Alpheus Spring	8/6/2019	-	-	1.3	-	-	-	-	-
Bill Jones Hatchery	8/6/2019	-	-	3.5	-	-	-	-	-
Clear Spring	8/6/2019	-	-	2.4	-	-	-	-	-
Minidoka Water Supply	8/6/2019	-	-	1.8	-	-	-	-	-
MV-03	7/16/2019	-	-	2.3	-	-	-	-	-
MV-05	7/16/2019	-	-	2.1	-	-	-	-	-
MV-07	7/16/2019	-	-	2.6	-	-	-	-	-
MV-13	7/17/2019	-	-	1.1	-	-	-	-	-
MV-27	7/16/2019	-	-	1.9	-	-	-	-	-
MV-36	7/16/2019	-	-	1.7	-	-	-	-	-
MV-38	7/17/2019	-	-	2.0	-	-	-	-	-
MV-40	7/17/2019	-	-	3.4	-	-	-	-	-
MV-53	7/16/2019	-	-	1.8	-	-	-	-	-
MV-56	7/17/2019	-	-	2.5	-	-	-	-	-
Shoshone Water Supply	8/6/2019	-	-	1.9	-	-	-	-	-

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
"-" = not analyzed.

Table 16. Dissolved nutrient concentrations (mg/L) in water samples, third quarter, 2019.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Upgradient					
Mud Lake Water Supply	8/7/2019	<0.01	U	0.036	
Distant					
Alpheus Spring	8/6/2019	2.2		0.021	
Bill Jones Hatchery	8/6/2019	1.2		0.017	
Clear Spring	8/6/2019	1.8		0.032	
Minidoka Water Supply	8/6/2019	1.3		0.015	
MV-03	7/16/2019	1.2		-	
MV-05	7/16/2019	3.8		-	
MV-07	7/16/2019	0.53		-	
MV-13	7/17/2019	2.2		-	
MV-27	7/16/2019	2.3		-	
MV-36	7/16/2019	1.7		-	
MV-38	7/17/2019	1.5		-	
MV-40	7/17/2019	0.99		-	
MV-53	7/16/2019	5.9		-	
MV-56	7/17/2019	1.4		-	
Shoshone Water Supply	8/6/2019	1.5		0.031	

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
* As N.
"-" = not analyzed.

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 third 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 17**. ^{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 17. Gamma spectroscopy analysis data for milk samples, third quarter, 2019.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Riverside	7/8/2019	1693	137	<MDC
	8/5/2019	1828	146	<MDC
Gooding/Glanbia	7/13/2019	1590	89	<MDC
	8/15/2019	1270	118	<MDC
	9/18/2019	1464	124	<MDC
Verification Samples[2]				
Terreton	7/2/2019	1470	118	<MDC
Dietrich	7/2/2019	1514	124	<MDC
Dietrich	8/6/2019	1410	114	<MDC
Idaho Falls	8/6/2019	1423	87	<MDC
Rupert	9/3/2019	1446	86	<MDC
Howe	9/3/2019	1305	116	<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 third 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 third quarter of 2019, DEQ-INL OP submitted 63 QC samples for various radiological and non-radiological analyses (**Table 18**).

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

Blank Samples

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

For all analyses except low-level tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For low-level tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 33 pCi/L.[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 third quarter of 2019 are presented in **Table 19**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 20**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 21**. Blank sample results for radiological and non-radiological analytes in ground and surface water are presented in **Tables 22-24**.

[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.

The gross beta blank for the TSP air filter collection period 07/03/19 – 07/11/19 had a value of 1.4E-3 pCi/m^3, which is above the MDA. All other TSP samples analyzed on the same date as the failed blank had gross beta concentrations greater than 10x the concentration measured in the blank. Therefore, no results were qualified or rejected based on this blank.

Both blank water samples (191W517 and 191W542) were measured to have 0.12 mg/L dissolved sodium, slightly above the detection limit for dissolved sodium (0.1 mg/L). Also, all other samples analyzed on the same date as the failed blank had dissolved sodium concentrations greater than 100x the concentration measured in the blank. Therefore, no results were qualified or rejected based on this sample.

All other blank sample results passed acceptance criteria in the third 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 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.

Duplicate results for radiological analyses in groundwater and surface water are presented in **Table 25-27**. All duplicate results passed acceptance criteria in the third 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 third 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 third quarter 2019 are presented in **Table 28**. 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 third 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 third 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 third 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 98.0% for the third quarter of 2019 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 18**. The overall data completeness (non-qualified results divided by the total number of field sample results expected) of 96.7% is also acceptable.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the third quarter of 2019 the TSP sampler at the Experimental Field Station was replaced. Service reliability for air sampling equipment for the third quarter of 2019 is summarized in **Table 29**.

Conclusion

All data collected for the third quarter of 2019 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 98.0% and data completeness of 96.7% are acceptable for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 18. Summary of the analyses in the third quarter, 2019.

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	146	13	0	0	6	ISU-EML
		Gross beta	146	13	0	0	6	ISU-EML
		Gamma emitters	12	1		0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	40	5	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	16	2	1	0	0	ISU-EML
		Gross beta	16	2	1	0	0	ISU-EML
		Gamma emitters	16	2	1	0	0	ISU-EML
		Tritium	16	2	1	0	0	ISU-EML
		Low-level tritium	23	0	1	0	0	ISU-EML
		Technetium-99	0	0	0	0	0	ISU-Sub
		Radiochemical	0	0	0	0	0	ISU Sub
		Metals	16	2	1	0	0	IBL
		Common Ions	16	2	1	0	0	IBL
		Nutrients	16	2	1	0	0	IBL
		Volatile Organics	0	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	11	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			**589**	**46**	**8**	**9**	**12**	
Total QC Analyses (blanks, duplicates, and spikes)			**63**					
QC Analyses as a percentage of total Test Analyses[3]			**10.7%**					
Percentage of usable data[4]			**98.0%**					

[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 19. Blank analysis results for gross alpha and beta (TSP), third quarter, 2019.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
06/27/19	07/03/19	2060	-0.1	0.1	-0.1	0.5
07/03/19	07/11/19	2060	0.2	0.1	1.4	0.4
07/11/19	07/18/19	2060	0.0	0.1	0.2	0.5
07/18/19	07/25/19	2060	0.0	0.1	-0.1	0.5
07/25/19	08/01/19	2060	0.0	0.1	0.2	0.5
08/01/19	08/08/19	2060	0.0	0.1	-0.4	0.4
08/08/19	08/15/19	2060	0.0	0.1	0.3	0.5
08/15/19	08/22/19	2060	0.1	0.1	0.0	0.4
08/22/19	08/29/19	2060	0.0	0.2	0.3	0.5
08/29/19	09/05/19	2060	0.0	0.1	-0.1	0.5
09/05/19	09/12/19	2060	0.1	0.1	-0.3	0.5
09/12/19	09/19/19	2060	0.1	0.1	0.1	0.5
09/19/19	09/26/19	2060	-0.1	0.1	-0.1	0.4

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 20. Blank analysis results for gamma spectroscopy for TSP air filters, composite samples, third 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
10/12/2019	-17	35	61	-32	80	141	4	11	18
Analysis Date	**Cesium-134**			**Cesium-137**		
	Concentration[1]	**± 2 SD**	**MDC**	**Concentration**	**± 2 SD**	**MDC**
10/12/2019	3	5	8	2	4	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 21. Blank analysis results for tritium in water vapor from air samples, third quarter, 2019.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP193ZTR01	10/27/19	10/27/19	11/01/19	0.00	0.09	0.16
OP193ZTR02	10/27/19	10/27/19	11/01/19	0.00	0.09	0.16
OP193ZTR03	10/27/19	10/28/19	11/01/19	-0.08	0.09	0.16
OP193Fridge	07/17/19	10/28/19	11/01/19	-0.09	0.12	0.20
OP193Sink	07/17/19	10/28/19	11/01/19	0.02	0.12	0.20

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

Table 22. Blank analysis results (pCi/L) for radiological constituents in water, third quarter, 2019.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
191W511	7/17/2019	Field	0.2	1.4	2.5	Yes
191W539	8/6/2019	Field	0.4	0.5	0.8	Yes
Gross Beta						
191W511	7/17/2019	Field	-1.1	1.4	2.4	Yes
191W539	8/6/2019	Field	0.8	0.6	1.0	Yes
Cesium-137						
191W511	7/17/2019	Field	0.5	1.3	2.3	Yes
191W539	8/6/2019	Field	0.2	1.3	2.2	Yes
Tritium (standard method)						
191W513	7/17/2019	Field	100	90	140	Yes
191W540	8/6/2019	Field	60	80	140	Yes

MDC = minimum detectable concentration.

Table 23. Blank analysis results (µg/L) for metals in groundwater and/or surface water, third quarter, 2019.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
191W517	7/17/2019	Field	-	-	<1.0	-	-	-	-	-
191W542	8/6/2019	Field	-	-	<1.0	-	-	-	-	-

Table 24. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, third quarter, 2019.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity†	NO_3+NO_2*	Total Phosphorus
191W517,515	7/17/2019	Field	<0.1	<0.1	0.12	<0.1	-	<0.4	<0.8	<1.0	<0.01	-
191W542,541	8/6/2019	Field	<0.1	<0.1	0.12	<0.1	-	<0.4	<0.8	<1.0	<0.01	<0.005

† As $CaCO_3$.
* As N.

Table 25. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, third 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?
Gross Alpha										
MV-03	191W464	2.0	1.2	191W470	1.3	1.1	42.4	0.7	2.4	Yes
Gross Beta										
MV-03	191W464	3.4	1.0	191W470	3.2	1.0	6.0	0.2	2.1	Yes
Cesium-137										
MV-03	191W464	1.2	2.2	191W470	0.2	1.9	143	1.0	4.4	Yes
Tritium (standard method)										
MV-03	191W466	-50	120	191W472	-130	110	-89	80.0	244	Yes
Tritium (low-level method)										
A11A31	191W281	102	11	191W348	96	10	6	6	22	Yes

RPD = relative percent difference.

Table 26. Duplicate results for metals (µg/L) in groundwater, third quarter, 2019.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
MV-03	191W468	7/16/2019	-	-	2.3	-	-	-	-	-
MV-03	191W474	7/16/2019	-	-	2.3	-	-	-	-	-
RPD			-	-	0.0	-	-	-	-	-

RPD = relative percent difference

Table 27. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, third quarter, 2019.

Sample Location	Sample Number	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
MV-03	191W468,467	7/16/2019	37	14	20	3.3	-	25.4	33.9	130	1.2	-
MV-03	191W474,473	7/16/2019	37	14	20	3.2	-	25.6	34	131	1.2	-
RPD			0	0	0	3	-	-1	0	-1	0	-

RPD = relative percent difference.
† As $CaCO_3$.
*Sample was filtered in the field.

Table 28. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2019.

Electret #	Exposure Received		Net Measured Exposure [1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SJE153	40.5	2.0	37.5	1.3	92.6%	Y
SJE076	40.5	2.0	36.6	1.3	90.4%	Y
SJW987	40.5	2.0	36.4	1.3	89.8%	Y
				Triplicate AVG:	**91.0%**	**Y**
SJE007	31.5	1.6	28.9	1.3	91.7%	Y
SJW993	31.5	1.6	26.0	1.3	82.6%	Y
SJE093	31.5	1.6	26.3	1.4	83.5%	Y
				Triplicate AVG:	**85.9%**	**Y**
SJE107	21.8	1.1	20.2	1.3	92.7%	Y
SJW987	21.8	1.1	19.7	1.3	90.4%	Y
SJX082	21.8	1.1	18.8	1.4	86.4%	Y
				Triplicate AVG:	**89.8%**	**Y**

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

Table 29. Air sampling field equipment service reliability (percent operational), third 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	92%	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	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, third 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	06/27/19	07/03/19	1.3	0.3	43.9	1.6
	07/03/19	07/11/19	1.5	0.3	42.5	1.3
	07/11/19	07/18/19	1.4	0.3	39.0	1.3
	07/18/19	07/23/19	1.9	0.4	39.4	1.6
	07/23/19	07/24/19	3.9	1.8	44.6	5.7
	07/24/19	07/25/19	2.0	1.4	19.6	4.2
	07/25/19	08/01/19	1.5	0.3	41.5	1.4
	08/01/19	08/08/19	1.9	0.3	49.5	1.5
	08/08/19	08/15/19	1.4	0.3	42.2	1.4
	08/15/19	08/22/19	1.2	0.2	35.5	1.2
	08/22/19	08/29/19	1.1	0.2	32.3	1.1
	08/29/19	09/05/19	NS[1]	NS[1]	NS[1]	NS[1]
	09/05/19	09/12/19	1.1	0.2	32.3	1.1
	09/12/19	09/19/19	0.9	0.2	31.4	1.1
	09/19/19	09/26/19	0.6	0.2	24.9	1.0
Experimental Field Station	06/27/19	07/03/19	1.1	0.3	32.3	1.4
	07/03/19	07/11/19	1.4	0.3	32.9	1.2
	07/11/19	07/18/19	1.0	0.2	27.4	1.2
	07/18/19	07/24/19	2.7	0.4	27.8	1.4
	07/29/19	08/01/19	1.9	0.6	33.6	2.3
	08/01/19	08/08/19	2.2	0.4	37.7	1.4
	08/08/19	08/15/19	3.3	0.5	35.9	1.6
	08/15/19	08/22/19	NS[2]	NS[2]	NS[2]	NS[2]
	08/22/19	08/29/19	3.0	0.4	34.4	1.4
	08/29/19	09/05/19	1.7	0.3	36.3	1.3
	09/05/19	09/12/19	1.2	0.2	23.7	1.0
	09/12/19	09/19/19	1.5	0.3	33.0	1.5
	09/19/19	09/26/19	0.6	0.3	22.3	1.1
Sand Dunes Tower	06/27/19	07/03/19	0.7	0.2	23.2	1.2
	07/03/19	07/11/19	0.5	0.2	21.2	0.9
	07/11/19	07/18/19	0.7	0.2	20.0	1.0
	07/18/19	07/25/19	0.9	0.2	21.7	1.0
	07/25/19	08/01/19	0.6	0.2	23.8	1.0
	08/01/19	08/08/19	0.9	0.2	29.5	1.2
	08/08/19	08/15/19	0.9	0.2	21.9	1.0
	08/15/19	08/22/19	1.1	0.3	25.8	1.2
	08/22/19	08/29/19	0.7	0.2	21.4	1.0
	08/29/19	09/05/19	0.7	0.2	27.7	1.1
	09/05/19	09/12/19	0.8	0.2	22.2	1.0
	09/12/19	09/19/19	0.7	0.2	21.3	1.0
	09/19/19	09/26/19	0.3	0.2	20.0	1.1

[1]Sampler was not turned on by technician this week.
[2]Sampler was non-functional on arrival 8/15. Replaced 8/22.

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, third quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	06/27/19	07/03/19	1.3	0.3	35.5	1.4
	07/03/19	07/11/19	1.8	0.3	46.9	1.3
	07/11/19	07/18/19	1.9	0.3	54.8	1.6
	07/18/19	07/23/19	3.1	0.5	54.6	1.9
	07/23/19	07/24/19	R[1]	R[1]	R[1]	R[1]
	07/24/19	07/25/19	2.4	1.7	77.4	6.5
	07/25/19	08/01/19	2.3	0.4	63.4	1.8
	08/01/19	08/08/19	3.1	0.5	74.6	2.4
	08/08/19	08/15/19	R[1]	R[1]	R[1]	R[1]
	08/15/19	08/22/19	2.1	0.3	63.5	1.7
	08/22/19	08/29/19	2.0	0.4	56.2	1.9
	08/29/19	09/05/19	R[1]	R[1]	R[1]	R[1]
	09/05/19	09/12/19	R[1]	R[1]	R[1]	R[1]
	09/12/19	09/19/19	2.2	0.5	75.0	2.5
	09/19/19	09/26/19	1.3	0.3	48.5	1.5
Boundary Locations						
Atomic City	06/27/19	07/03/19	1.5	0.3	41.3	1.5
	07/03/19	07/11/19	1.5	0.3	41.3	1.3
	07/11/19	07/18/19	1.3	0.3	33.9	1.3
	07/18/19	07/24/19	2.4	0.4	36.3	1.5
	07/24/19	07/25/19	0.7	1.2	36.2	4.4
	07/25/19	08/01/19	1.2	0.3	39.8	1.4
	08/01/19	08/08/19	1.9	0.3	47.4	1.5
	08/08/19	08/15/19	1.5	0.3	40.7	1.4
	08/15/19	08/22/19	1.4	0.3	38.6	1.3
	08/22/19	08/29/19	1.4	0.3	39.2	1.3
	08/29/19	09/05/19	1.7	0.3	53.0	1.5
	09/05/19	09/12/19	1.3	0.3	38.3	1.3
	09/12/19	09/19/19	1.1	0.2	37.4	1.3
	09/19/19	09/26/19	1.0	0.3	30.9	1.2
Howe	06/27/19	07/03/19	0.9	0.3	22.9	1.2
	07/03/19	07/11/19	0.9	0.2	25.6	1.0
	07/11/19	07/18/19	0.8	0.2	20.6	1.1
	07/18/19	07/25/19	1.1	0.3	22.2	1.1
	07/25/19	08/01/19	0.7	0.2	22.1	1.1
	08/01/19	08/08/19	1.0	0.3	30.5	1.2
	08/08/19	08/15/19	0.9	0.2	23.9	1.1
	08/15/19	08/22/19	0.8	0.2	25.4	1.1
	08/22/19	08/29/19	0.8	0.2	21.9	1.1
	08/29/19	09/05/19	0.9	0.2	27.4	1.2
	09/05/19	09/12/19	0.7	0.2	22.1	1.1
	09/12/19	09/19/19	0.6	0.2	21.7	1.1
	09/19/19	09/26/19	0.3	0.2	17.0	1.0

[1]Insufficient sample volume for analysis.

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, third quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	06/27/19	07/03/19	1.4	0.3	33.0	1.4
	07/03/19	07/11/19	1.0	0.2	31.0	1.1
	07/11/19	07/18/19	1.0	0.2	25.1	1.1
	07/18/19	07/25/19	1.3	0.3	26.7	1.2
	07/25/19	08/01/19	0.9	0.2	28.2	1.2
	08/01/19	08/08/19	1.1	0.3	32.0	1.3
	08/08/19	08/15/19	1.2	0.3	26.9	1.2
	08/15/19	08/22/19	1.1	0.3	28.3	1.2
	08/22/19	08/29/19	1.2	0.3	25.0	1.2
	08/29/19	09/05/19	1.2	0.3	32.3	1.3
	09/05/19	09/12/19	0.9	0.2	28.0	1.2
	09/12/19	09/19/19	0.9	0.2	26.4	1.2
	09/19/19	09/26/19	0.5	0.2	19.8	1.0
Mud Lake	06/27/19	07/03/19	1.4	0.3	33.4	1.4
	07/03/19	07/11/19	1.3	0.2	36.2	1.2
	07/11/19	07/18/19	1.4	0.3	32.4	1.2
	07/18/19	07/25/19	1.8	0.3	28.5	1.2
	07/25/19	08/01/19	1.1	0.3	33.2	1.3
	08/01/19	08/08/19	1.3	0.3	44.2	1.4
	08/08/19	08/15/19	1.9	0.3	38.7	1.3
	08/15/19	08/22/19	1.2	0.3	32.6	1.2
	08/22/19	08/29/19	2.0	0.3	31.9	1.2
	08/29/19	09/05/19	1.7	0.3	41.5	1.4
	09/05/19	09/12/19	1.4	0.3	31.1	1.2
	09/12/19	09/19/19	1.3	0.3	31.5	1.3
	09/19/19	09/26/19	0.6	0.2	26.5	1.1
Distant Locations						
Craters of the Moon	06/27/19	07/03/19	0.7	0.2	25.0	1.2
	07/03/19	07/11/19	0.9	0.2	33.0	1.1
	07/11/19	07/18/19	0.9	0.2	24.9	1.1
	07/18/19	07/25/19	1.1	0.3	24.7	1.1
	07/25/19	08/01/19	0.8	0.2	23.9	1.1
	08/01/19	08/08/19	1.3	0.3	36.7	1.3
	08/08/19	08/15/19	0.8	0.2	26.2	1.1
	08/15/19	08/22/19	0.7	0.2	24.5	1.1
	08/22/19	08/29/19	1.0	0.3	24.1	1.1
	08/29/19	09/05/19	1.0	0.2	30.9	1.2
	09/05/19	09/12/19	1.0	0.2	27.2	1.2
	09/12/19	09/19/19	0.9	0.3	29.5	1.6
	09/19/19	09/26/19	0.4	0.2	18.3	1.0

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, third quarter, 2019.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	06/27/19	07/03/19	1.9	0.3	41.5	1.5
	07/03/19	07/11/19	1.4	0.2	40.1	1.2
	07/11/19	07/18/19	1.4	0.3	36.6	1.3
	07/18/19	07/25/19	1.7	0.3	35.6	1.3
	07/25/19	08/01/19	R[2]	R[2]	R[2]	R[2]
	08/01/19	08/08/19	1.9	0.3	52.1	1.5
	08/08/19	08/15/19	1.5	0.3	36.8	1.3
	08/15/19	08/22/19	1.9	0.3	38.5	1.3
	08/22/19	08/29/19	2.0	0.4	45.5	1.6
	08/29/19	09/05/19	2.0	0.3	44.5	1.4
	09/05/19	09/12/19	1.7	0.3	42.6	1.4
	09/12/19	09/19/19	1.3	0.3	38.0	1.3
	09/19/19	09/26/19	1.1	0.3	27.7	1.2
Idaho Falls	06/27/19	07/03/19	R[2]	R[2]	R[2]	R[2]
	07/03/19	07/11/19	1.3	0.2	39.5	1.2
	07/11/19	07/18/19	1.6	0.3	35.3	1.3
	07/18/19	07/25/19	1.5	0.5	34.3	2.0
	07/25/19	08/01/19	1.1	0.3	38.9	1.3
	08/01/19	08/08/19	1.5	0.3	43.1	1.4
	08/08/19	08/15/19	1.4	0.3	37.9	1.3
	08/15/19	08/22/19	1.3	0.3	32.1	1.2
	08/22/19	08/29/19	1.7	0.4	33.9	1.5
	08/29/19	09/05/19	R[2]	R[2]	R[2]	R[2]
	09/05/19	09/12/19	1.4	0.3	41.6	1.4
	09/12/19	09/19/19	1.1	0.2	30.3	1.2
	09/19/19	09/26/19	0.6	0.2	23.3	1.1

[1]Sampler owned and operated by the Shosone-Bannock Tribes.
[2] Insufficient sample volume for analysis.

Appendix B

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	12.9	3.1
Craters of the Moon	12.5	1.9
Rest Area	14.8	1.8
Van Buren Avenue	15.0, 17.0	-
Experimental Field Station	12.7, 13.5	-
Main Gate	16.3, 17.4	-
Atomic City	13.0, 16.2	-
Taber	13.9	2.4
Blackfoot	11.0	3.0
Ft. Hall	12.5, 14.1	-
Idaho Falls	12.3	2.6
Mud Lake/ Terreton	13.3	3.2
Monteview	12.5, 13.6	-
Sand Dunes	14.1	3.0
Howe Met. Tower	12.2	2.1
MP282 -20	15.1, 16.2	-
MP280 -20	11.4	2.8
MP278 -20	14.0, 12.4	-
MP276 -20	10.8, 11.8	-
MP274 -20	10.5	1.2
MP272 -20	13.3	3.5
MP270 -20	13.3, 15.7	-
MP268 -20	15.3, 15.4	-
MP266 -20	15.2, 16.0	-
MP264 -20	14.9	3.7
MP270 -20/26	16.0, 18.6	-
MP268 -20/26	12.6, 14.0	-
MP266 -20/26	19.4, 21.2	-
MP263 -20/26	14.6	3.4
MP261 -20/26	15.1	3.3
MP259 -20/26	11.3, 12.2	-
MP256 -20/26	11.1, 13.7	-
MFC (EBR II)	13.0	1.8
EBR I	11.8	0.8
RWMC	13.7	1.3
CFA	14.8	3.2
CITRC (PBF)	13.9	3.8
INTEC	18.4	1.6
ATR (TRA)	12.5	1.2
NRF	14.0, 15.0	-
TAN/SMC	13.7	2.8
Mud Lake Bank of Commerce	13.3	1.4
MP43-33	13.4	1.6
MP41-33	13.7	2.7

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP33-33	13.7, 16.0	-
MP31-33	12.4, 13.8	-
MP29-33	12.5	1.1
MP27-33	14.0	3.0
MP25-33	14.4, 14.5	-
MP23-33	12.9	1.6
MP21-33	12.3	3.6
MP19-33	13.9	0.9
MP14-33	8.3, 9.0	-
MP11-33	13.8	3.2
MP06-33	11.7, 13.3	-
MP03-33	13.1, 13.6	-
Base of Howe	13.2, 13.4	-
Rover	17.9, 18.0	-
Hamer	15.9	2.9
Sugar City	14.6, 15.3	-
Roberts	13.5, 14.9	-
Big Southern Butte	9.5, 11.0	-
T4 North	13.3	1.4
T4 South	14.5	0.5

[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.