Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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Boise Office
1410 N. Hilton
Boise, Idaho 83706
208-373-0428

Idaho Falls Office
900 N. Skyline, Suite B
Idaho Falls, Idaho 83402
208-528-2600

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

Introduction

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

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

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

Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the third quarter, 2020 (**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**. Results are within the expected historical range. A new sampler model was designed and recommended by the manufacturer in an attempt to remedy inaccuracy and mechanical issues observed with some of the older models. These new samplers were first deployed on September 2, 2020. The lack of data at the locations shown in **Appendix A** was a result of lead times to receive replacement units and getting the new units tested and installed. The partial week samples and insufficient volumes in **Appendix A** were a result of filter overloading due to smoky conditions from regional wildfires.

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. The partial week filters and insufficient volume filters were included in these composite samples. Typically, gamma spectroscopy analyses yield only less-than MDC results for man-made gamma-emitting radionuclides; in that case only Cs-137 results are reported. Gamma spectroscopy results for the third quarter of 2020 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

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 canisters 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. The weighted mean value from the Experimental Field Station exceeded the MDC, as did all three individual sample results from that location. The weighted mean from Sand Dunes exceeded the MDC, as did one of the individual sample results. One individual sample result exceeded the MDC from Van Buren Avenue, Mud Lake, Big Lost River Rest Area, and Monteview, although the weighted mean values from these locations were all below their MDCs. All other sample results were below their MDCs. Sample results from all locations were well below the DEQ-INL OP action level of 150 pCi/m^3 (40 CFR 61). Weighted mean atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the third quarter of 2020. 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 2020. 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**.

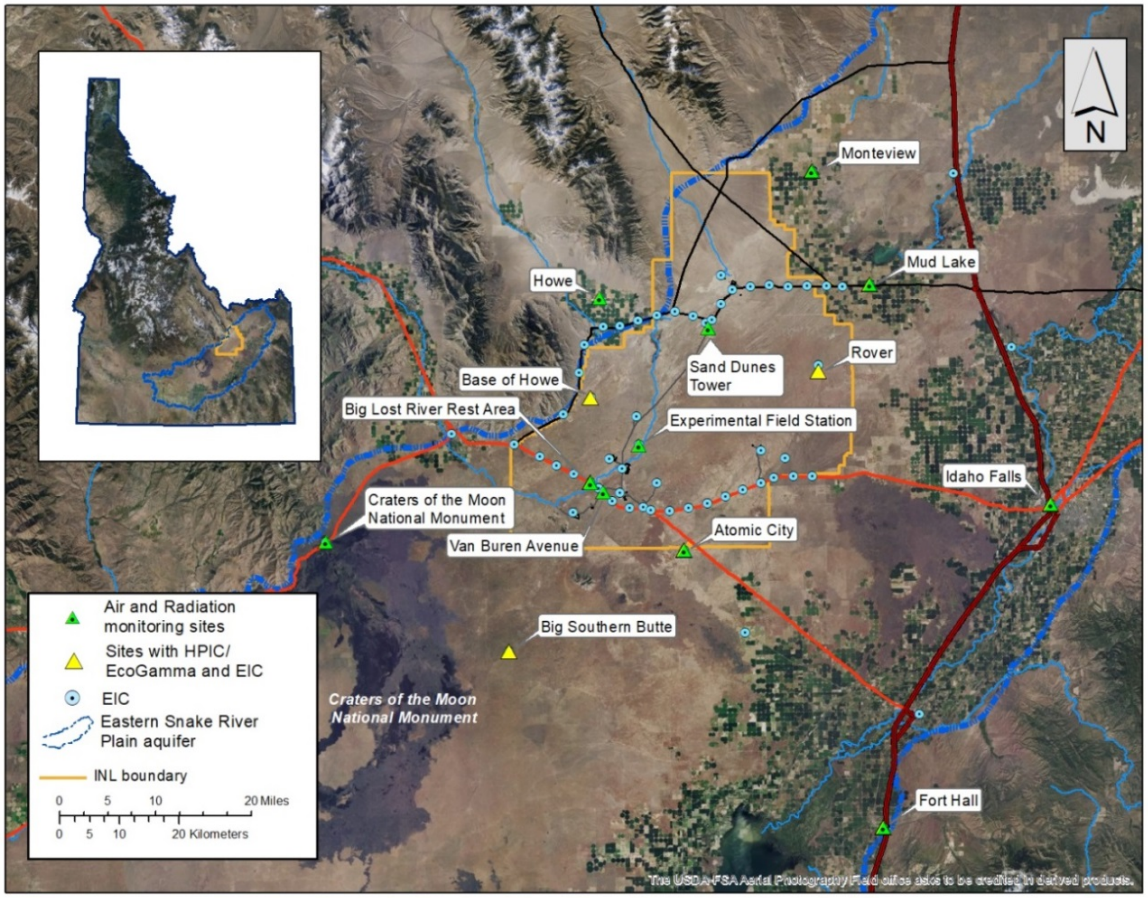

Figure 1. Air and radiation monitoring locations.

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, 2020.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.7	-	3.0	29.2	-	49.0
Experimental Field Station	0.8	-	1.8	20.6	-	36.8
Sand Dunes Tower	0.9	-	2.7	35.7	-	56.1
Van Buren Avenue	0.6	-	1.8	12.2	-	39.1
Boundary Locations						
Atomic City	0.8	-	2.4	23.9	-	40.2
Howe	1.6	-	2.5	24.8	-	34.6
Monteview	0.7	-	1.4	21.8	-	35.9
Mud Lake	1.0	-	3.4	24.3	-	48.4
Distant Locations						
Craters of the Moon[2]	1.2	-	1.2	32.6	-	32.6
Fort Hall[1]	1.2	-	4.5	35.1	-	64.7
Idaho Falls	1.4	-	3.5	27.6	-	48.3
Idaho Falls Duplicate[3]	1.7		3.9	29.8		51.8

Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.
[1]Operated by Shoshone-Bannock Tribes.
[2]Sampler was off-line for repair/replacement for most of the quarter. Only one weekly sample was collected.
[3]A duplicate sampler is being operated at the Idaho Falls location.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, third quarter, 2020.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides[2]		
	Concentration	± 2 SD	Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Area	171.5	9.2	0.00	0.04	0.07
Experimental Field Station	130.0	6.8	0.05	0.06	0.10
Sand Dunes Tower	210.0	10.8	0.04	0.06	0.10
Van Buren Avenue	117.0	6.2	-0.01	0.03	0.06
Boundary Locations					
Atomic City	136.1	7.1	0.02	0.03	0.05
Howe	138.0	7.5	0.07	0.06	0.09
Monteview	196.6	13.6	-0.06	0.27	0.47
Mud Lake	164.2	8.4	0.01	0.05	0.08
Distant Locations					
Craters of the Moon	273.6	18.0	-0.23	0.30	0.56
Fort Hall[1]	211.1	10.9	0.03	0.08	0.08
Idaho Falls	261.4	14.1	0.17	0.18	0.29
Idaho Falls Duplicate[3]	232.5	13.0	0.03	0.15	0.25

[1]Operated by Shoshone-Bannock Tribes.
[2]No man-made radionuclides were detected. Concentration, ± 2 SD, and MDC are listed for Cs-137, a man-made gamma-emitting radionuclide likely to be detected in TSP samples.
[3]A duplicate sampler is being operated at the Idaho Falls location.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 4. Weighted mean tritium concentrations in air from atmospheric moisture, third quarter, 2020.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.67	0.43	0.67
Experimental Field Station	0.86	0.45	0.71
Sand Dunes Tower	0.76	0.43	0.66
Van Buren Avenue	0.42	0.42	0.68
Boundary Locations			
Atomic City	0.03	0.39	0.67
Howe	0.13	0.53	0.90
Mud Lake	0.60	0.62	1.00
Monteview	0.77	0.58	0.92
Distant Locations			
Craters of the Moon	0.03	0.38	0.65
Fort Hall[1]	0.48	0.49	0.80
Idaho Falls	0.28	0.36	0.59

[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, 2020.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	80	120	190	0.5	1.5	2.5
Boundary Locations						
Atomic City	100	120	190	0.3	2.0	3.3
Howe	50	120	190	-0.2	1.2	2.1
Monteview	150	120	190	0.8	1.7	2.9
Mud Lake	90	120	190	1.3	1.2	1.9
Distant Locations						
Idaho Falls	40	120	190	2.6	2.0	3.3

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

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the third quarter of 2020 (**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 transmitted 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/EcoGammas for third quarter 2020. **Table 8** lists the EIC monitoring results for third quarter 2020. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

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 2020, from HPIC/EcoGamma* network.

Station Location	Exposure Rate (µR/hr)	
	Weekly Average	± 2 SD
On-site Locations		
Base of Howe	19.3	1.5
Big Lost River Rest Area	10.9	5.2
Rover	17.8	1.4
Sand Dunes Tower	16.2	1.2
Boundary Locations		
Atomic City	12.6	2.5
Big Southern Butte	16.7	1.3
Howe Met Tower	15.3	11.7
Monteview	12.6	2.2
Mud Lake / Terreton	13.3	1.2
Distant Locations		
Fort Hall	14.7	9.3
Idaho Falls	7.9	3.4

*The HPIC's and EcoGammas are sensitive electronic devices that can experience intermittent malfunctions and/or interference; this typically results in characteristic positive and/or negative data spikes. These aberrations are removed from the data set based on the judgement of the data analyst.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, third quarter, 2020.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	13.8	1.0
Big Lost River Rest Area	13.1, 15.2	-
Experimental Field Station	10.3	2.1
Rover	14.3	1.7
Sand Dunes Tower	12.9	2.2
Van Buren Avenue	16.0	1.9
Boundary Locations		
Atomic City	9.4	2.8
Big Southern Butte	13.0	1.3
Howe Met Tower	10.3, 10.6	-
Monteview	15.7, 16.9	-
Mud Lake/Terreton	14.7, 16.1	-
Distant Location		
Craters of the Moon	12.7	2.5
Fort Hall	12.9, 13.6	-
Idaho Falls	10.3	3.0

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

During the third quarter of 2020, DEQ-INL OP sampled groundwater from the aquifer at one facility location, 18 distant locations including 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 19** and summarized below. The results of low-level tritium analyses for 15 samples collected in second and third quarter 2020 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.

[1] Distant locations Alpheus Spring, Bill Jones Hatchery, Clear Spring, Minidoka Water Supply, and Shoshone Water Supply and upgradient location Mud Lake Water Supply are sampled only for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the third and fourth quarters. Samples for chloride, chromium, nitrate-plus-nitrate, and other constituents are collected at these locations during the third quarter.

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-43 where a slightly elevated value of 8.7 ± 3.0 pCi/L was measured. The gross beta concentrations at MV-11 (9.7 ± 1.4 pCi/L) and MV-43 (9.8 ± 2.3 pCi/L) were slightly above the natural background range typically observed in the aquifer, but were consistent with their historical ranges. 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 detected at the single facility well sampled this quarter, USGS-123 at INTEC, with a value of 1710 ± 170 pCi/L. This value follows a decreasing tritium concentration trend at USGS-123.

Six samples from third quarter 2020 and eight from second quarter 2020 requiring low-level tritium analysis were analyzed this quarter, and the results are reported in **Table 13**. Three samples are from boundary wells, three are from facility wells, and the remaining eight are from upgradient and distant water locations. All reported concentrations are within the background range (< 33 pCi/L). A backlog of 32 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.

One facility location, USGS-123, was sampled for ^{90}Sr, ^{99}Tc, and uranium isotopes this quarter (**Tables 14, 15, and 16).** ^{90}Sr, ^{99}Tc, and ^{235}U were not detected. The ^{234}U concentration (1.32 ± 0.33 pCi/L) was within the typical ESRP aquifer background range. The ^{238}U concentration (0.77 ± 0.23 pCi/L) was slightly above the background range (0.021 – 0.719 pCi/L) but consistent with historical values.

Common ions, trace metals, and nutrients

All locations were sampled for chloride, chromium, and dissolved nutrients (nitrate-plus-nitrite). Three locations (USGS-123, MV-63, and MV-65) were sampled for other common ions. Only the facility location, USGS-123, was sampled for all listed trace metals and phosphorus during the quarter (**Tables 17, 18, and 190**).

Most results were consistent with past results with some elevated compared to background concentrations. MV-43 had elevated concentrations of nitrate + nitrite (37 mg/L, well above the MCL of 10 mg/L) and chloride (79.9 mg/L). These elevated concentrations are consistent with increasing trends at MV-43 and reflect an increase in nutrient concentration due to increased agricultural practices in the Magic Valley. 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.

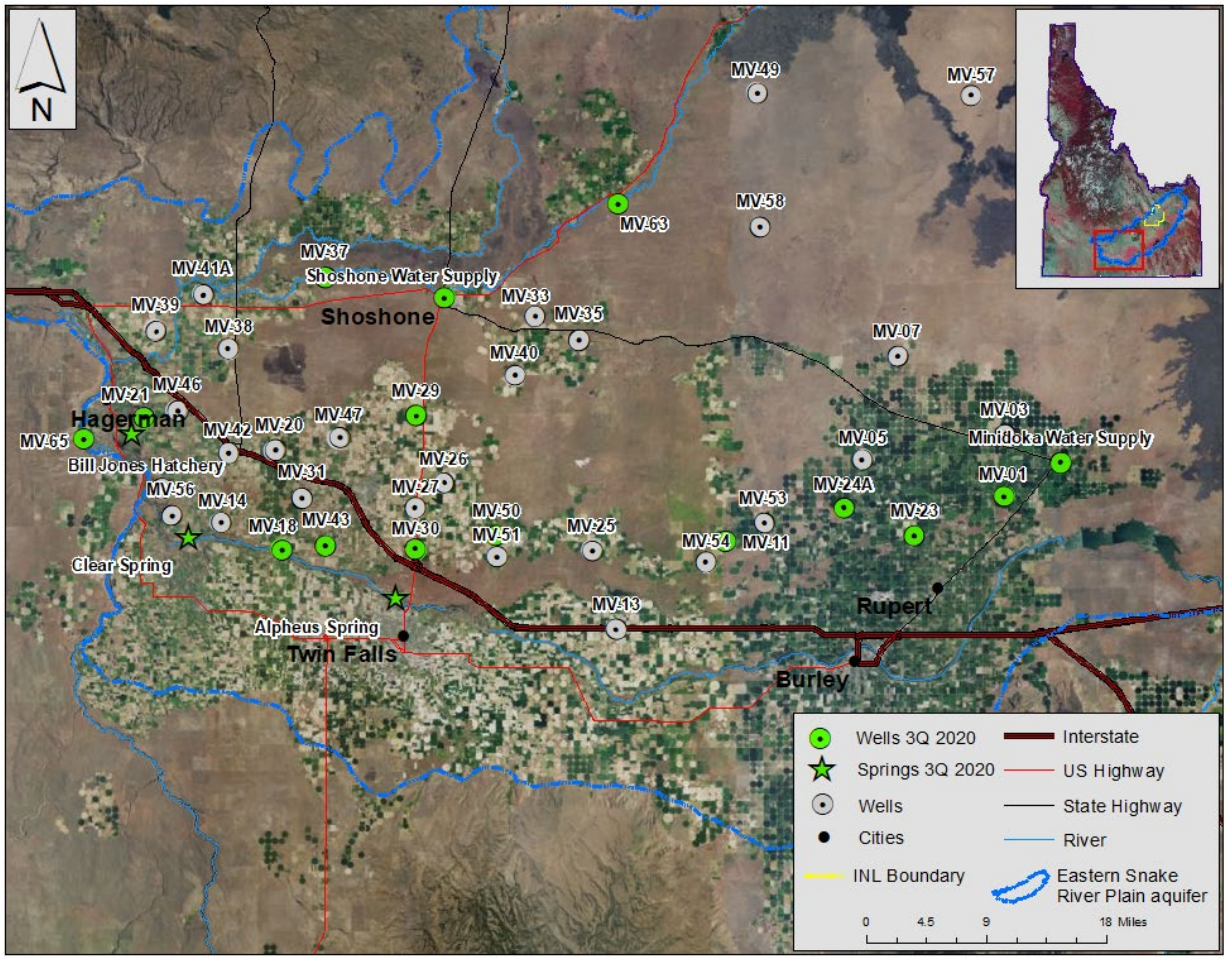

Figure 2. Distant and Surface Water monitoring locations.

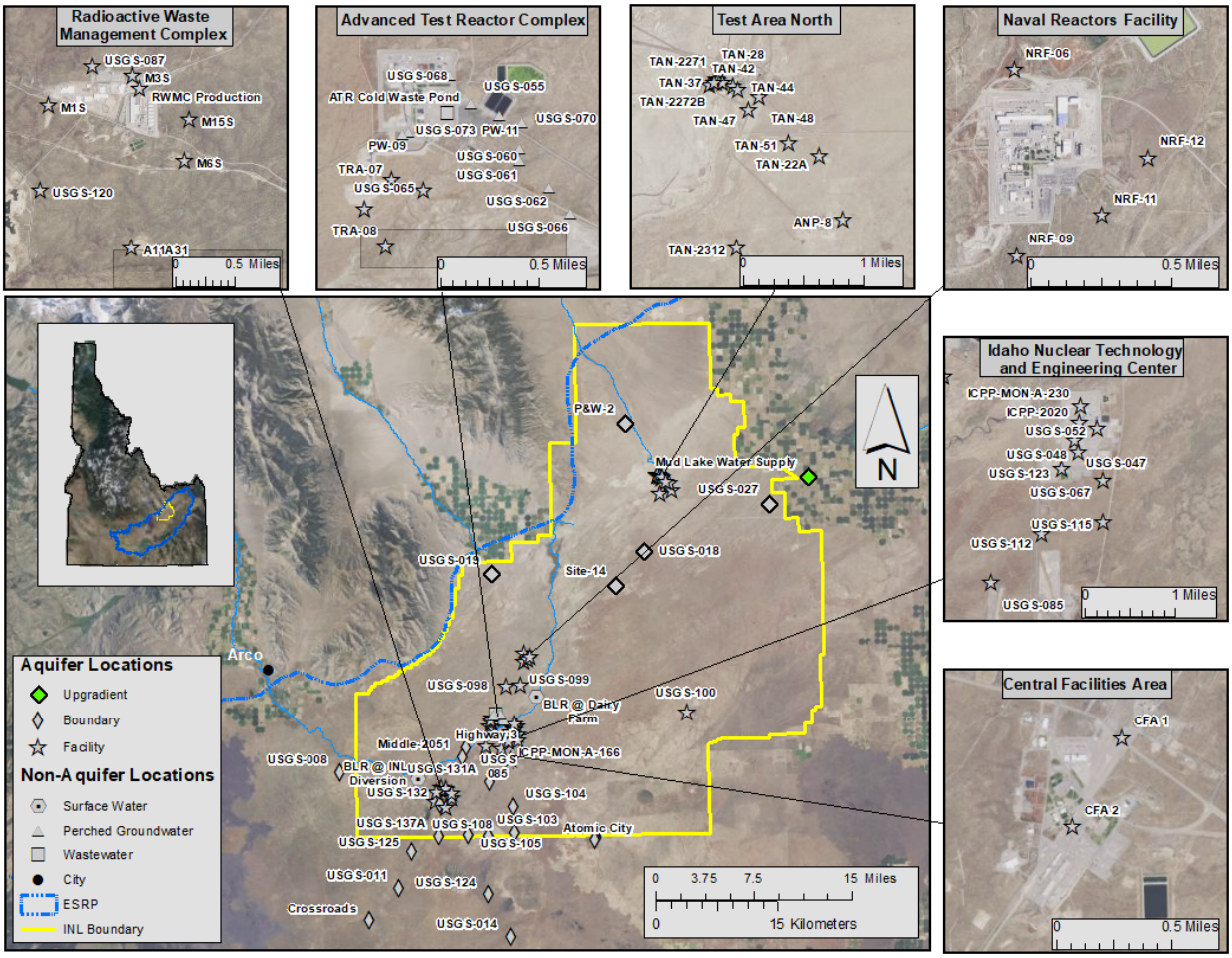

Figure 3. Up-gradient, facility, boundary, perched groundwater (GW) and wastewater monitoring locations.

Table 9. Locations sampled for water, third quarter, 2020.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	7/16/2020	None	330	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-123	9/02/2020	Fluor	515	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, com. ions, trace metals, NO_3+NO_2, P
Distant				
Alpheus Spring	7/13/2020	None	0	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
Bill Jones Hatchery	7/14/2020	None	0	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
Clear Spring	7/14/2020	None	0	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
Minidoka Water Supply	7/14/2020	None	282	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-01	7/13/2020	None	n/a	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-11	7/13/2020	None	218	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-18	7/14/2020	None	341	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-21	7/14/2020	None	118	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-23	7/13/2020	None	180	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-24A	7/13/2020	None	130	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-29	7/13/2020	None	280	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-30	7/13/2020	None	371	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-37	7/13/2020	None	200	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-43	7/14/2020	None	200	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-50	7/13/2020	None	422	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2
MV-63	8/20/2020	None	369	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2, com. ions
MV-65	8/20/2020	None	420	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2, com. ions
Shoshone Water Supply	7/13/2020	None	715	α, β, γ, ^{3}H, Cl, Cr, NO_3+NO_2

ft bgs = feet below ground surface.
*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; ^{3}H = tritium; ^{90}Sr = Strontium-90, ^{99}Tc = Technetium-99, U iso. = ^{234}U, ^{235}U, ^{238}U; Cl = chloride; Cr = chromium; com. ions = Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, alkalinity; trace metals = arsenic (As), barium (Ba), chromium (Cr), iron (Fe), manganese (Mn), lead (Pb), selenium (Se); NO_3+NO_2 = nitrate plus nitrite; P = phosphorus.
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	<1.0 – 5.2[a]	100
Iron	4 – 16[d]	300*
Lead	<5[c]	15
Manganese	<1 – 4[a]	50*
Selenium	<1[c]	50
Zinc	<3 – 10.5[d]	5000*
Nutrients (mg/L)		
Nitrate plus nitrite	<0.04 – 3.59[b]	10 for NO_3^-, 1 for NO_2^-
Phosphorus	<0.01 – 0.02[d]	---
Volatile Organic Compounds (µg/L)		
Tetrachloroethene (PCE)	0	5
Trichloroethene (TCE)	0	5
1,1-Dichloroethene	0	7
cis-1,2-dichloroethene	0	70
trans-1,2-dichloroethene	0	100
Vinyl chloride	0	2
Carbon tetrachloride	0	5
Chloroform	0	80[e]
Chloromethane	0	---
Methylene Chloride	0	5
Methyl Ethyl Ketone	0	---
1,1-Dichloroethane	0	---

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

Table 11. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) for water samples, third quarter, 2020.

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	7/16/2020	0.2	U	0.5	4.3		0.8	0.9	U	1.6
Facility										
Idaho Nuclear Technology and Engineering Center										
USGS-123	9/02/2020	2.3		1.2	3.8		1.0	0.6	U	1.7
Distant										
Alpheus Spring	7/13/2020	2.5		1.2	7.5		1.1	1.5	U	1.9
Bill Jones Hatchery	7/14/2020	1.5		0.8	3.0		0.9	0.6	U	1.2
Clear Spring	7/14/2020	1.1	U	0.9	3.8		0.9	-0.6	U	1.6
Minidoka Water Supply	7/14/2020	2.0		1.0	3.7		0.9	0.0	U	1.4
MV-01	7/13/2020	1.8		1.1	8.3		1.1	-0.3	U	1.9
MV-11	7/13/2020	4.0		1.7	9.7		1.4	0.5	U	1.2
MV-18	7/14/2020	2.2	U	1.6	6.8		1.2	0.7	U	1.2
MV-21	7/14/2020	2.1		1.0	3.2		0.9	-0.4	U	1.7
MV-23	7/13/2020	1.6		1.1	6.6		1.1	1.6	U	1.9
MV-24A	7/13/2020	2.7		1.4	8.6		1.2	-1.0	U	1.5
MV-29	7/13/2020	2.2		1.0	4.1		0.9	0.9	U	1.4
MV-30	7/13/2020	4.1		1.5	7.6		1.2	-0.5	U	1.5
MV-37	7/13/2020	3.2		1.0	4.2		0.9	1.2	U	1.4
MV-43	7/14/2020	8.7		3.0	9.8		2.3	-0.3	U	1.2
MV-50	7/13/2020	3.3		1.4	7.1		1.1	1.9	U	1.6
MV-63	8/20/2020	1.3	U	1.1	3.6		0.9	-0.1	U	1.6
MV-65	8/20/2020	1.4	U	1.4	6.1		1.1	-0.3	U	1.2
Shoshone Water Supply	7/13/2020	1.7		0.8	2.7		0.8	0.9	U	1.2

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*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 12. Tritium concentrations (pCi/L) for water samples, third quarter, 2020.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	7/16/2020	-100	U	90
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-123	9/2/2020	1710		170
Distant				
Alpheus Spring	7/13/2020	0	U	100
Bill Jones Hatchery	7/14/2020	-70	U	90
Clear Spring	7/14/2020	-40	U	90
Minidoka Water Supply	7/14/2020	50	U	100
MV-01	7/13/2020	10	U	100
MV-11	7/13/2020	-10	U	90
MV-18	7/14/2020	-40	U	90
MV-21	7/14/2020	-60	U	90
MV-23	7/13/2020	-60	U	90
MV-24A	7/13/2020	-30	U	90
MV-29	7/13/2020	0	U	100
MV-30	7/13/2020	-40	U	90
MV-37	7/13/2020	10	U	100
MV-43	7/14/2020	-10	U	90
MV-50	7/13/2020	-20	U	90
MV-63	8/20/2020	-50	U	100
MV-65	8/20/2020	0	U	100
Shoshone Water Supply	7/13/2020	-30	U	90

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

Table 13. Low-level tritium concentrations (pCi/L) in samples collected during 2020 and analyzed using the electrolytic enrichment method third quarter, 2020.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Upgradient				
P&W-2	4/6/2020	2	U	7
USGS-018	4/6/2020	2	U	7
Facility				
Naval Reactors Facility				
NRF-09	4/13/2020	12	U	8
NRF-11	4/13/2020	21		8
NRF-12	4/13/2020	5	U	7
Boundary				
USGS-008	4/15/2020	6	U	7
USGS-011	4/27/2020	19		8
USGS-108	6/17/2020	29		7
Distant				
MV-11	7/13/2020	14		6
MV-23	7/13/2020	13		8
MV-24A	7/13/2020	9		8
MV-29	7/13/2020	5		5
MV-30	7/13/2020	12		7
MV-43	7/14/2020	24		9

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. Strontium-90 concentrations (pCi/L) in water samples, third quarter, 2020.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-123	9/2/2020	0.11	U	0.20

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

Table 15. Technetium-99 concentrations (pCi/L) in water samples, third quarter, 2020.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-123 (dissolved)	9/2/2020	1.0	U	2.8

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

Table 16. Uranium isotope concentrations (pCi/L) for water samples, third quarter, 2020.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Idaho Nuclear Technology and Engineering Center										
USGS-123	9/2/2020	1.32		0.33	0.085	U	0.074	0.77		0.23

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. Common ion concentrations (mg/L) in water samples, third quarter, 2020.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Fluoride		Chloride		Sulfate		Alkalinity†	
Aquifer Samples																	
Upgradient																	
Mud Lake Water Supply	7/16/2020	-	-	-	-	-	-	-	-	-	-	4.93		-	-	-	-
Facility																	
Idaho Nuclear Technology and Engineering Center																	
USGS-123*	9/2/2020	40		15		10		2.9		<0.20		21.6		22.0		127	
Distant																	
Alpheus Spring	7/13/2020	-	-	-	-	-	-	-	-	-	-	43.4		-	-	-	-
Bill Jones Hatchery	7/14/2020	-	-	-	-	-	-	-	-	-	-	11.5		-	-	-	-
Clear Spring	7/14/2020	-	-	-	-	-	-	-	-	-	-	31.3		-	-	-	-
Minidoka Water Supply	7/14/2020	-	-	-	-	-	-	-	-	-	-	37.0		-	-	-	-
Shoshone Water Supply	7/13/2020	-	-	-	-	-	-	-	-	-	-	6.21		-	-	-	-
MV-01	7/13/2020	-	-	-	-	-	-	-	-	-	-	41.8		-	-	-	-
MV-11*	7/13/2020	-	-	-	-	-	-	-	-	-	-	73.4		-	-	-	-
MV-18	7/14/2020	-	-	-	-	-	-	-	-	-	-	50.9		-	-	-	-
MV-21	7/14/2020	-	-	-	-	-	-	-	-	-	-	12.1		-	-	-	-
MV-23	7/13/2020	-	-	-	-	-	-	-	-	-	-	32.1		-	-	-	-
MV-24A	7/13/2020	-	-	-	-	-	-	-	-	-	-	59.6		-	-	-	-
MV-29	7/13/2020	-	-	-	-	-	-	-	-	-	-	18.2		-	-	-	-
MV-30	7/13/2020	-	-	-	-	-	-	-	-	-	-	50.8		-	-	-	-
MV-37	7/13/2020	-	-	-	-	-	-	-	-	-	-	12.5		-	-	-	-
MV-43	7/14/2020	-	-	-	-	-	-	-	-	-	-	79.9		-	-	-	-
MV-50	7/13/2020	-	-	-	-	-	-	-	-	-	-	55.2		-	-	-	-
MV-63	8/20/2020	43		17		15		2.9		-	-	5.22		15.9		189	
MV-65	8/20/2020	53		21		33		4.5		-	-	48.6		59.7		165	

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 not filtered in the field.
† As $CaCO_3$.
"-" = not analyzed.

Table 18. Dissolved metals concentrations (µg/L) in water samples, third quarter, 2020.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Aquifer Samples																	
Upgradient																	
Mud Lake Water Supply	7/16/2020	-	-	-	-	<1	U	-	-	-	-	-	-	-	-	-	-
Facility																	
Idaho Nuclear Technology and Engineering Center																	
USGS-123	9/2/2020	<2.0	U	48		15		550		<1.0	U	8.0	U	<2.0	U	<5.0	U
Distant																	
Alpheus Spring	7/13/2020	-	-	-	-	1.8		-	-	-	-	-	-	-	-	-	-
Bill Jones Hatchery	7/14/2020	-	-	-	-	3.7		-	-	-	-	-	-	-	-	-	-
Clear Spring	7/14/2020	-	-	-	-	2.8		-	-	-	-	-	-	-	-	-	-
Minidoka Water Supply	7/14/2020	-	-	-	-	2.3		-	-	-	-	-	-	-	-	-	-
Shoshone Water Supply	7/13/2020	-	-	-	-	2.6		-	-	-	-	-	-	-	-	-	-
MV-01	7/13/2020	-	-	-	-	1.7		-	-	-	-	-	-	-	-	-	-
MV-11	7/13/2020	-	-	-	-	2.3		-	-	-	-	-	-	-	-	-	-
MV-18	7/14/2020	-	-	-	-	2.3		-	-	-	-	-	-	-	-	-	-
MV-21	7/14/2020	-	-	-	-	3.7		-	-	-	-	-	-	-	-	-	-
MV-23	7/13/2020	-	-	-	-	-[1]		-	-	-	-	-	-	-	-	-	-
MV-24A	7/13/2020	-	-	-	-	2.4		-	-	-	-	-	-	-	-	-	-
MV-29	7/13/2020	-	-	-	-	3.5		-	-	-	-	-	-	-	-	-	-
MV-30	7/13/2020	-	-	-	-	2.1		-	-	-	-	-	-	-	-	-	-
MV-37	7/13/2020	-	-	-	-	1.6		-	-	-	-	-	-	-	-	-	-
MV-43	7/14/2020	-	-	-	-	1.7		-	-	-	-	-	-	-	-	-	-
MV-50	7/13/2020	-	-	-	-	2.3		-	-	-	-	-	-	-	-	-	-
MV-63	8/20/2020	-	-	-	-	1.2		-	-	-	-	-	-	-	-	-	-
MV-65	8/20/2020	-	-	-	-	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.
[1]Sample result not currently available.

Table 19. Dissolved nutrient concentrations (mg/L) in water samples, third quarter, 2020.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Upgradient					
Mud Lake Water Supply	7/16/2020	<0.01	U	-	
Facility					
Idaho Nuclear Technology and Engineering Center					
USGS-123	9/2/2020	1.1		0.03	
Distant					
Alpheus Spring	7/13/2020	2.2		-	-
Bill Jones Hatchery	7/14/2020	1.3		-	-
Clear Spring	7/14/2020	1.7		-	-
Minidoka Water Supply	7/14/2020	1.3		-	-
MV-01	7/13/2020	1.1		-	-
MV-11	7/13/2020	6.3		-	-
MV-18	7/14/2020	3.5		-	-
MV-21	7/14/2020	1.8		-	-
MV-23	7/13/2020	5.0		-	-
MV-24A	7/13/2020	6.4		-	-
MV-29	7/13/2020	0.79		-	-
MV-30	7/13/2020	3.7		-	-
MV-37	7/13/2020	2.0		-	-
MV-43	7/14/2020	37		-	-
MV-50	7/13/2020	2.8		-	-
MV-63	8/20/2020	1.3		-	-
MV-65	8/20/2020	2.2		-	-
Shoshone Water Supply	7/13/2020	1.3		-	-

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, but 24 soil samples (including two duplicates) were physically collected during the third calendar quarter of 2020.

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 20**. ^{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 20. Gamma spectroscopy analysis data for milk samples, third quarter, 2020.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131		
		Concentration[2]	± 2 SD	Concentration[2]	± 2 SD	MDC
Monitoring Samples						
Gooding	7/26/2020	1574	129	-2.0	2.9	5.0
	8/31/2020	1427	116	-1.3	1.6	2.9
	9/15/2020	1473	87	0.2	1.4	2.3
Riverside	7/5/2020	1762	135	0.9	1.1	1.9
	8/2/2020	1927	145	0.3	1.2	2.1
	9/7/2020	2026	154	1.0	2.5	4.1
Verification Samples[1]						
Terreton	7/6/2020	1440	87	0.5	1.4	2.3
Rupert	7/7/2020	1556	129	1.8	2.1	3.4
Idaho Falls	8/4/2020	1467	123	2.1	3.7	6.1
Dietrich	8/4/2020	1494	88	-1.8	3.2	5.4
Rupert	9/1/2020	1519	126	0.4	2.0	3.4
Howe	9/2/2020	1445	86	-0.2	1.1	1.8

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

Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation capable of identifying and measuring *in-situ* concentrations of gamma-emitting radionuclides in soil. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons. Twenty four soil samples were collected and prepared in the field at eleven locations (two samples taken at St. Anthony were duplicates) during the third calendar quarter of

2020 (**see Figure 4**). ^{137}Cs was the only man made gamma emitting radionuclide detected. Analysis results for ^{137}Cs concentrations for physical soil samples are shown in **Table 21.**

Table 21. Gamma spectroscopic analysis results (Cs-137) for physical soil sampling conducted during the third calendar quarter of 2020.

Location	Sample Type[1]	Sample Depth (cm)	Date Collected	Concentration[2]	±2 SD	MDC
Butte City	Puck	0 to 5	7/28/2020	0.26	0.07	0.13
Butte City	Puck	5 to 10	7/28/2020	0.12	0.04	0.09
Carey	Puck	0 to 5	7/28/2020	0.57	0.10	0.14
Carey	Puck	5 to 10	7/28/2020	0.23	0.06	0.09
Crystal Ice Caves	Puck	0 to 5	8/7/2020	0.27	0.06	0.10
Crystal Ice Caves	Puck	5 to 10	8/7/2020	0.16	0.05	0.09
FAA Tower	Puck	0 to 5	7/28/2020	0.36	0.07	0.13
FAA Tower	Puck	5 to 10	7/28/2020	0.12	0.05	0.09
Frenchman's Cabin	Puck	0 to 5	7/28/2020	0.40	0.07	0.11
Frenchman's Cabin	Puck	5 to 10	7/28/2020	0.26	0.06	0.09
Howe	Puck	0 to 5	7/21/2020	0.17	0.05	0.08
Howe	Puck	5 to 10	7/21/2020	0.03 U[3]	0.03	0.08
Monteview	Puck	0 to 5	7/21/2020	0.08	0.04	0.07
Monteview	Puck	5 to 10	7/21/2020	0.08	0.04	0.08
Mud Lake #1	Puck	0 to 5	7/21/2020	0.29	0.06	0.08
Mud Lake #1	Puck	5 to 10	7/21/2020	0.17	0.04	0.08
Mud Lake #2	Puck	0 to 5	7/21/2020	0.10	0.04	0.09
Mud Lake #2	Puck	5 to 10	7/21/2020	0.09	0.04	0.08
Reno Ranch	Puck	0 to 5	7/21/2020	0.48	0.08	0.11
Reno Ranch	Puck	5 to 10	7/21/2020	0.26	0.07	0.13
St. Anthony	Puck	0 to 5	7/21/2020	0.40	0.08	0.13
St. Anthony	Puck	5 to 10	7/21/2020	0.19	0.06	0.13

[1]Soil samples were collected in a "puck" (a cylindrical plastic container with a diameter of 6.5 cm and a height of 2.2 cm) and prepared in the field for gamma spectroscopic analysis at ISU.
[2]Concentrations reported in pCi/g.
[3]U = Non-detection.

The average Cesium-137 value was 0.24 picocuries per gram (pCi/g) with a minimum value of 0.03 pCi/g and a maximum of 0.57 pCi/g, well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g (NCRP Report 129). Based upon terrestrial radiological measurements of soil and milk, there were no discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

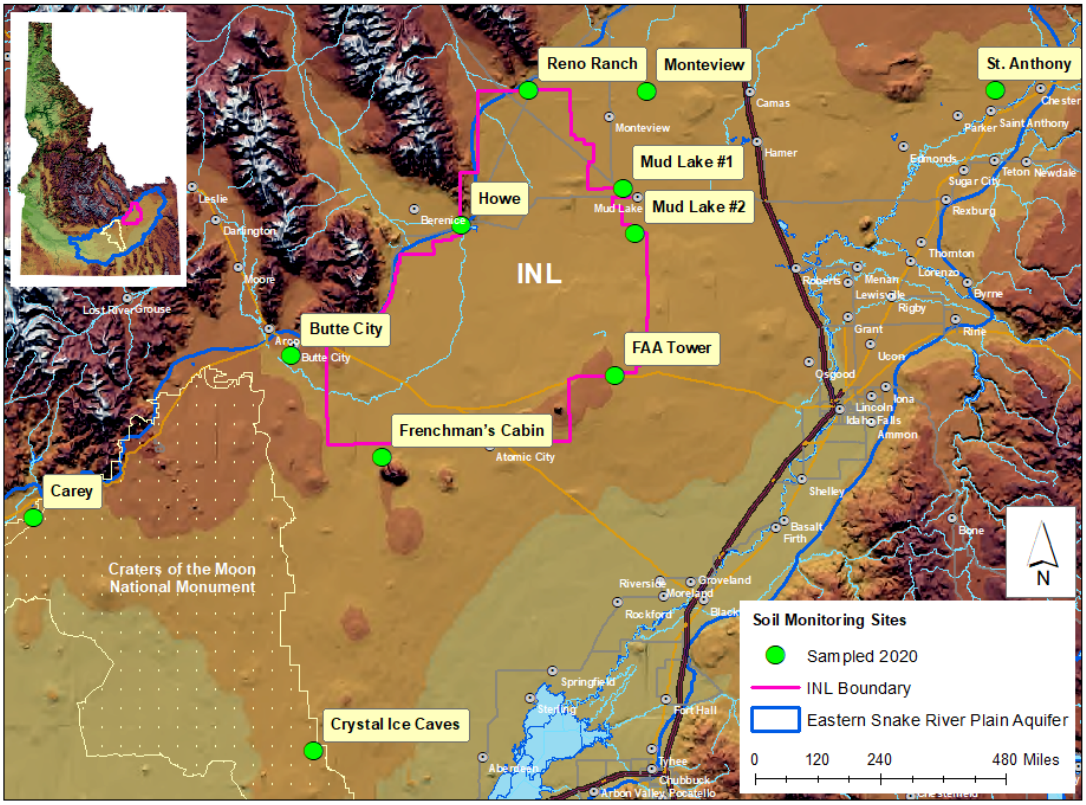

Figure 4. Physical soil monitoring sites, third quarter 2020.

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 2020. 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 2020, DEQ-INL OP submitted 73 QC samples for various radiological and non-radiological analyses (**Table 22**).

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

Blank Samples

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

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

Blank sample results submitted for gross alpha and gross beta screening in air for the third quarter of 2020 are presented in **Table 23**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 24**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 25**. Blank sample results for radiological and non-radiological analytes in ground and surface water are presented in **Tables 26-28**.

[2] 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.

Two blank analyses for tritium in water vapor in air were greater than MDC and therefore failed acceptance criteria. Two other blank analyses performed on the same day met acceptance criteria. There was only one field sample result greater than MDC and analyzed on the same day as the failed blanks. This result was qualified as a biased high estimate (J+). All other blank sample results passed acceptance criteria in the third quarter of 2020.

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 29-31**. Duplicate results for soil grab samples are presented in **Table 32.** All duplicate results passed acceptance criteria in the third quarter of 2020.

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 2020.

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 2020 are presented in **Table 33**. 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 2020.

Qualification of Low Level Sample Results

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

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

Analytical QA/QC Assessment

Other than the two failed blanks discussed above, no issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the third quarter of 2020 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 2020.

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 87.1% for the third quarter of 2020 is below the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 22**. The overall data completeness (usable results divided by the total number of field sample results expected) of 81.3% is also below the acceptable value of 90%. The low data usability and completeness values are primarily due to TSP air samplers removed from service upon the discovery of inaccurate flow rates and mechanical issues. The lack of data (NS = no sample) at the locations shown in **Appendix A** was a result of lead times to receive replacement units. Also the partial week samples and insufficient air sample volumes in **Appendix A** were a result of more frequent filter changes due to filter overloading caused by smoky conditions from regional wildfires. These frequent filter changes often resulted in TSP samples which had less than the minimum acceptable volume of air passed through them, and results were therefore rejected (R). No corrective action for filter overloading is indicated since wildfire smoke is unavoidable. With the installation of replacement TSP samplers and the end of wildfire season it is anticipated that the data usability and completeness values will return to acceptable levels in following quarters.

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

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the third quarter of 2020 the TSP sampler at Craters of the Moon was out of service from 7/1/20 to 9/21/20, when a new model HVP-4300VFC sampler was deployed there. The Howe TSP sampler was out of service from 8/12/20 to 9/14/20, when a new HVP-4300VFC sampler was deployed there. The Idaho Falls and Idaho Falls duplicate TSP samplers were out of service from7/1/20 to 9/2/20, when new HVP-4300VFC samplers were deployed there. The Monteview TSP sampler was out of service from 7/1/20 to 9/18/20, when a new HVP-4300VFC sampler was deployed there.

For the week of 9/9/20 to 9/16/20, only four out of eleven radioiodine samples were obtained for the weekly composite, due to a temporary shortage of filter canisters. The samples obtained were from Big Lost River Rest Area, Experimental Field Station, Mud Lake, and Fort Hall. Service reliability for air sampling equipment for the third quarter of 2020 is summarized in **Table 34**.

Conclusion

All data collected for the third quarter of 2020 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 87.1% and data completeness of 81.3% are below the acceptable level of 90% for the quarter, with the data otherwise meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 22. Summary of analyses in the third quarter, 2020.

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	140	13	0	0	40	ISU-EML
		Gross beta	140	13	0	0	40	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	36	7	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13 (Note 6)	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	20	2	2	0	0	ISU-EML
		Gross beta	20	2	2	0	0	ISU-EML
		Gamma emitters	20	2	2	0	0	ISU-EML
		Tritium	20	2	2	0	0	ISU-EML
		Low-level tritium	14	1	0	0	0	ISU-EML
		Radiochemical	3	0	0	0	0	ISU Sub
		Metals	20	2	1	0	0	IBL
		Common Ions	20	2	2	0	0	IBL
		Nutrients	20	2	2	0	0	IBL
		Volatile Organics	0	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	12	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	22	0	2	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	67	0	0	9	0	DEQ-INL OP
	HPICs/Eco Gammas	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			**622**	**49**	**15**	**9**	**80**	
Total QC analyses performed (blanks, duplicates, and spikes)			**73**					
Ratio of total QC analyses to total sample analyses[3]			**11.7%**					
Data usability[4], percent			**87.1%**					
Data completeness[5], percent			**81.3%**					

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

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

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

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

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

[6] For the week of 9/9/20 to 9/16/20, only four out of eleven radioiodine samples were obtained for the weekly composite.

Table 23. Blank analysis results for gross alpha and beta in TSP air filters, third quarter, 2020.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
07/01/20	07/08/20	1935	0.1	0.1	0.4	0.5
07/08/20	07/15/20	1935	-0.1	0.2	-0.9	0.5
07/15/20	07/22/20	1935	0.0	0.2	-0.3	0.5
07/22/20	07/29/20	1935	-0.1	0.1	0.3	0.5
07/29/20	08/05/20	1935	0.1	0.1	0.2	0.5
08/05/20	08/12/20	1935	0.0	0.2	0.2	0.5
08/12/20	08/19/20	1935	0.0	0.2	0.4	0.5
08/19/20	08/26/20	1935	0.0	0.1	0.4	0.5
08/26/20	09/02/20	1935	0.1	0.2	0.4	0.5
09/02/20	09/09/20	1935	-0.2	0.2	-0.5	0.5
09/09/20	09/16/20	1935	0.1	0.2	0.5	0.5
09/16/20	09/23/20	1935	-0.2	0.2	0.2	0.5
09/23/20	09/30/20	1935	-0.1	0.2	-0.6	0.6

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 24. Blank analysis results for gamma spectroscopy for TSP air filters, composite samples, third quarter, 2020.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
10/27/2020	-19	34	61	36	69	115	-7	7	14
Analysis Date	**Cesium-134**			**Cesium-137**		
	Concentration[1]	**± 2 SD**	**MDC**	**Concentration**	**± 2 SD**	**MDC**
10/27/2020	-2	3	6	-2	3	5

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 25. Blank analysis results for tritium in water vapor from air samples, third quarter, 2020.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP203ZTR01	09/01/20	09/04/20	11/10/20	0.01	0.09	0.16
OP203ZTR02	09/01/20	09/04/20	11/10/20	0.07	0.09	0.15
OP203ZTR03	11/16/20	11/19/20	11/24/20	0.23	0.10	0.15
OP203ZTR03[1]	11/16/20	11/19/20	11/25/20	0.33	0.16	0.26
OP203ZTR04	11/16/20	11/19/20	11/24/20	0.33	0.16	0.26
OP203Fridge	09/01/20	11/20/20	11/24/20	0.00	0.09	0.15
OP203Sink	09/01/20	11/20/20	11/24/20	-0.03	0.09	0.15

Note: Concentrations are expressed in nCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC). L refers to liters of water, not air.

[1]Re-analysis 1.

Table 26. Blank analysis results (pCi/L) for radiological constituents in water, third quarter, 2020.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
201W555	07/13/2020	Field	0.2	0.3	0.5	Yes
201W545	07/14/2020	Field	-0.2	0.2	0.4	Yes
Gross Beta						
201W555	07/13/2020	Field	0.1	0.6	1.0	Yes
201W545	07/14/2020	Field	-0.2	0.6	1.1	Yes
Cesium-137						
201W555	07/13/2020	Field	0.6	1.7	2.8	Yes
201W545	07/14/2020	Field	1.5	1.4	2.2	Yes
Tritium (standard method)						
201W556	07/13/2020	Field	0	90	160	Yes
201W546	07/14/2020	Field	20	100	160	Yes
Tritium (low-level method)						
201W243	04/06/2020	Field	25	9	13	Yes*

MDC = minimum detectable concentration.
*Detections in this range are typical of the DI water used by DEQ to prepare blank samples.

Table 27. Blank analysis results (µg/L) for metals in groundwater and/or surface water, third quarter, 2020.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
201W548	7/14/2020	Field	-	-	<1.0	-	-	-	-	-
201W558	7/13/2020	Field	-	-	<1.0	-	-	-	-	-

Table 28. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, third quarter, 2020.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity	NO_3+NO_2*	Total Phosphorus
201W547, 549	7/14/2020	Field	-	-	-	-	-	<0.4	-	-	<0.01	-
201W557, 559	7/13/2020	Field	-	-	-	-	-	<0.4	-	-	<0.01	-

† As $CaCO_3$.

* As N.

Table 29. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, third quarter, 2020.

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-18	201W470	2.2	1.6	201W550	3.0	1.4	-31	0.8	3.2	Yes
MV-65	201W575	1.4	1.4	201W570	0.9	1.3	43	0.5	2.9	Yes
Gross Beta										
MV-18	201W470	6.8	1.2	201W550	6.6	1.1	3	0.2	2.4	Yes
MV-65	201W575	6.1	1.1	201W570	4.7	1.0	26	1.4	2.2	Yes
Cesium-137										
MV-18	201W470	0.7	1.2	201W550	1.5	2.0	-73	0.8	3.5	Yes
MV-65	201W575	-0.3	1.2	201W570	0.7	1.1	-500	1.0	2.4	Yes
Tritium (standard method)										
MV-18	201W471	-40	90	201W551	-50	90	22	10	191	Yes
MV-65	201W571	0	100	201W576	0	100	0	0	212	Yes

RPD = relative percent difference.

Table 30. Duplicate results for metals (µg/L) in groundwater, third quarter, 2020.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
MV-18	201W473	7/14/2020	-	-	2.3	-	-	-	-	-
MV-18	201W553	7/14/2020	-	-	2.0	-	-	-	-	-
RPD			-	-	14	-	-	-	-	-

RPD = relative percent difference.

Table 31. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, third quarter, 2020.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total P*
MV-18	201W472, 474	7/14/2020	-	-	-	-	-	50.9	-	-	3.5	-
MV-18	201W552, 554	7/14/2020	-	-	-	-	-	51.9	-	-	3.6	-
RPD							-	-2			-3	
MV-65	201W572, 573, 577, 579	8/20/2020	53	21	33	4.5	-	48.6	59.7	165	2.2	-
MV-65	201W572, 574, 577, 578	8/20/2020	53	21	33	4.6	-	48.8	59.6	166	2.1	-
RPD			0	0	0	-2	-	-0.4	0.2	-0.6	5	-

RPD = relative percent difference
† As $CaCO_3$.
*P = phosphorus.

Table 32. Duplicate sample results for soil grab samples, third quarter, 2020.

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?
Cs-137										
St. Anthony, 0-5 cm	OP203SASR01	0.40	0.08	OP203SASR03	0.39	0.07	3	0.01	0.16	Yes
St. Anthony, 5-10 cm	OP203SASR02	0.19	0.06	OP203SASR04	0.29	0.06	-42	0.10	0.13	Yes

RPD = relative percent difference.

Table 33. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2020.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SJX032	44.0	2.2	38.4	1.3	87.4%	Y
SKR395	44.0	2.2	43.1	1.3	97.9%	Y
SKR371	44.0	2.2	36.4	1.4	82.7%	Y
				Triplicate AVG:	**89.3%**	**Y**
SJE096	30.0	1.5	29.1	1.3	96.8%	Y
SJE034	30.0	1.5	27.5	1.3	91.5%	Y
SJE057	30.0	1.5	28.3	1.3	94.2%	Y
				Triplicate AVG:	**94.2%**	**Y**
SJW980	21.2	1.1	17.8	1.3	83.8%	Y
SKR368	21.2	1.1	19.8	1.3	93.6%	Y
SKR345	21.2	1.1	18.1	1.3	85.4%	Y
				Triplicate AVG:	**87.6%**	**Y**

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

Table 34. Air sampling field equipment service reliability (percent operational), third quarter, 2020.

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%	92%	100%	NC[1]
Van Buren Avenue	100%	92%	100%	NC[1]
Boundary Locations				
Atomic City	100%	92%	100%	100%
Howe	64%	92%	100%	100%
Monteview	15%	92%	100%	100%
Mud Lake	100%	100%	100%	100%
Distant Locations[2]				
Craters of the Moon	10%	92%	100%	NC[1]
Idaho Falls	31%	92%	100%	100%

Note: The values in this table were calculated by dividing the number of weeks the equipment was in operation by the number of weeks in the quarter.

[1] NC = Sample not collected at this location.

[2] The Fort Hall Station, operated by the Shoshone- Bannock Tribes, is not included here.

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, 2020.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	07/01/20	07/08/20	1.4	0.3	35.2	1.3
	07/08/20	07/15/20	0.7	0.2	31.9	1.2
	07/15/20	07/22/20	1.0	0.2	29.3	1.2
	07/22/20	07/29/20	1.8	0.3	38.8	1.3
	07/29/20	08/05/20	1.4	0.3	45.3	1.4
	08/05/20	08/12/20	1.1	0.3	29.8	1.2
	08/12/20	08/19/20	1.3	0.3	37.2	1.6
	08/21/20*	08/24/20	R[2]	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	1.5	0.3	35.5	1.3
	09/02/20	09/09/20	R	R	R	R
	09/09/20*	09/14/20	3.0	0.5	49.0	1.8
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.1	0.4	34.9	1.6
	09/23/20	09/30/20	1.2	0.3	29.2	1.2
Experimental Field Station	07/01/20	07/08/20	1.1 J[1]	0.2 J	23.6 J	1.1 J
	07/08/20	07/15/20	1.2	0.3	23.0	1.1
	07/15/20	07/22/20	0.8	0.2	23.8	1.1
	07/22/20	07/29/20	1.2	0.3	27.3	1.2
	07/29/20	08/05/20	1.5	0.3	36.8	1.3
	08/05/20	08/12/20	1.1	0.3	24.8	1.1
	08/12/20	08/19/20	1.5	0.3	36.0	1.4
	08/19/20*	08/21/20	R[2]	R	R	R
	08/21/20*	08/24/20	R	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	1.1	0.3	24.4	1.1
	09/02/20	09/09/20	1.8	0.3	25.3	1.2
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	1.8	0.4	24.9	1.4
	09/23/20	09/30/20	1.3	0.3	20.6	1.0
Sand Dunes Tower	07/01/20	07/08/20	1.3	0.3	45.1	1.4
	07/08/20	07/15/20	1.2	0.3	35.7	1.3
	07/15/20	07/22/20	0.9	0.2	36.4	1.3
	07/22/20	07/29/20	1.6	0.4	47.9	1.8
	07/29/20	08/05/20	1.6	0.3	53.1	1.5
	08/05/20	08/12/20	1.4	0.3	36.7	1.3
	08/12/20	08/19/20	1.7	0.4	39.2	1.6
	08/19/20*	08/21/20	R[2]	R	R	R
	08/21/20*	08/24/20	R	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	R	R	R	R
	09/02/20	09/09/20	R	R	R	R
	09/09/20*	09/14/20	2.7	0.5	56.1	2.2
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.4	0.5	40.0	1.9
	09/23/20	09/30/20	2.0	0.5	41.8	1.8

* Partial week sample.
[1] Volume was estimated. Result is qualified as an estimate (J).
[2] R - Result was rejected. 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, 2020.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	07/01/20	07/08/20	1.3	0.3	34.6	1.3
	07/08/20	07/15/20	1.1	0.3	28.0	1.2
	07/15/20	07/22/20	1.2	0.3	31.5	1.2
	07/22/20	07/29/20	1.8	0.3	39.1	1.3
	07/29/20	08/05/20	1.2	0.3	37.1	1.3
	08/05/20	08/12/20	1.1	0.3	31.5	1.2
	08/12/20	08/19/20	1.2	0.3	29.7	1.2
	08/19/20*	08/21/20	R[1]	R	R	R
	08/21/20*	08/24/20	R	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	0.6	0.2	14.4	0.9
	09/02/20	09/09/20	0.9	0.3	12.2	0.8
	09/09/20*	09/14/20	1.3	0.3	15.4	1.1
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	1.2	0.3	26.4	1.4
	09/23/20	09/30/20	0.9	0.3	23.5	1.1
Boundary Locations						
Atomic City	07/01/20	07/08/20	0.8	0.2	25.7	1.1
	07/08/20	07/15/20	0.8	0.2	23.9	1.1
	07/15/20	07/22/20	1.2	0.3	27.1	1.1
	07/22/20	07/29/20	1.8	0.3	31.5	1.2
	07/29/20	08/05/20	1.7	0.3	35.3	1.3
	08/05/20	08/12/20	1.0	0.3	26.9	1.1
	08/12/20	08/19/20	1.1	0.3	31.2	1.2
	08/19/20*	08/21/20	R[1]	R	R	R
	08/21/20*	08/24/20	R	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	1.3	0.3	28.6	1.2
	09/02/20	09/09/20	1.8	0.4	29.2	1.4
	09/09/20*	09/14/20	2.4	0.4	40.2	1.6
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.1	0.4	32.9	1.5
	09/23/20	09/30/20	1.1	0.3	24.2	1.1
Howe	07/01/20	07/08/20	2.5	0.4	33.8	1.4
	07/08/20	07/15/20	1.9	0.3	28.5	1.2
	07/15/20	07/22/20	1.7	0.3	32.6	1.3
	07/22/20	07/29/20	1.9	0.3	34.6	1.3
	07/29/20	08/05/20	1.6	0.3	27.3	1.2
	08/05/20	08/12/20	2.2	0.4	31.9	1.3
	08/12/20	08/19/20	NS[3]	NS	NS	NS
	08/19/20	08/26/20	NS	NS	NS	NS
	08/26/20	09/02/20	NS	NS	NS	NS
	09/02/20	09/09/20	NS	NS	NS	NS
	09/14/20[2]	09/16/20	R[1]	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.1	0.5	34.6	1.6
	09/23/20	09/30/20	2.1	0.4	24.8	1.2

* Partial week sample.
[1] R - Result was rejected. Insufficient sample volume for analysis.
[2] Partial week sample. New Model HVP-4300VFC sampler deployed.
[3] NS – No sample. Sampler was out of service for repair/replacement.

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, 2020.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	07/01/20	07/08/20	NS[1]	NS	NS	NS
	07/08/20	07/15/20	NS	NS	NS	NS
	07/15/20	07/22/20	NS	NS	NS	NS
	07/22/20	07/29/20	NS	NS	NS	NS
	07/29/20	08/05/20	NS	NS	NS	NS
	08/05/20	08/12/20	NS	NS	NS	NS
	08/12/20	08/19/20	NS	NS	NS	NS
	08/19/20	08/26/20	NS	NS	NS	NS
	08/26/20	09/02/20	NS	NS	NS	NS
	09/02/20	09/09/20	NS	NS	NS	NS
	09/09/20*	09/14/20	NS	NS	NS	NS
	09/18/20[3]	09/23/20	1.4	0.4	35.9	1.6
	09/23/20	09/30/20	0.7	0.3	21.8	1.1
Mud Lake	07/01/20	07/08/20	1.1	0.2	27.9	1.2
	07/08/20	07/15/20	1.1	0.3	28.3	1.2
	07/15/20	07/22/20	1.0	0.3	29.3	1.2
	07/22/20	07/29/20	1.1	0.3	30.5	1.2
	07/29/20	08/05/20	1.7	0.3	40.2	1.4
	08/05/20	08/12/20	1.0	0.3	27.9	1.2
	08/12/20	08/19/20	1.7	0.3	36.1	1.3
	08/19/20*	08/21/20	R[2]	R	R	R
	08/21/20*	08/24/20	R	R	R	R
	08/24/20*	08/26/20	R	R	R	R
	08/26/20	09/02/20	1.5	0.3	33.9	1.3
	09/02/20	09/09/20	2.0	0.4	29.9	1.4
	09/09/20*	09/14/20	3.4	0.5	48.4	1.8
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	1.9	0.4	35.9	1.7
	09/23/20	09/30/20	1.4	0.3	24.3	1.1
Distant Locations						
Craters of the Moon	07/01/20	07/08/20	NS[1]	NS	NS	NS
	07/08/20	07/15/20	NS	NS	NS	NS
	07/15/20	07/22/20	NS	NS	NS	NS
	07/22/20	07/29/20	NS	NS	NS	NS
	07/29/20	08/05/20	NS	NS	NS	NS
	08/05/20	08/12/20	NS	NS	NS	NS
	08/12/20	08/19/20	NS	NS	NS	NS
	08/19/20	08/26/20	NS	NS	NS	NS
	08/26/20	09/02/20	NS	NS	NS	NS
	09/02/20	09/09/20	NS	NS	NS	NS
	09/09/20	09/16/20	NS	NS	NS	NS
	09/21/20[3]	09/23/20	R[2]	R	R	R
	09/23/20	09/30/20	1.2	0.3	32.6	1.3

* Partial week sample.
[1] NS - No sample. Sampler was out of service for repair/replacement.
[2] R - Result was rejected. Insufficient sample volume for analysis.
[3] Partial week sample. New Model HVP-4300VFC sampler deployed.

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, 2020.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	07/01/20	07/08/20	1.4	0.3	40.0	1.3
	07/08/20	07/15/20	1.2	0.3	36.8	1.3
	07/15/20	07/22/20	1.2	0.3	35.1	1.3
	07/22/20	07/29/20	1.3	0.3	45.4	1.4
	07/29/20	08/05/20	2.1	0.3	51.6	1.5
	08/05/20	08/12/20	1.5	0.3	35.8	1.3
	08/12/20	08/19/20	2.1	0.4	45.9	1.5
	08/21/20*	08/26/20	R[2]	R	R	R
	08/26/20	09/02/20	2.1	0.3	44.9	1.4
	09/02/20	09/09/20	2.7	0.4	38.6	1.5
	09/09/20*	09/14/20	4.5	0.6	60.6	2.2
	09/14/20*	09/16/20	R	R	R	R
	09/16/20*	09/22/20	3.5	0.5	64.7	1.9
	09/22/20**	09/30/20	2.3	0.4	46.7	1.6
Idaho Falls	07/01/20	07/08/20	NS[3]	NS	NS	NS
	07/08/20	07/15/20	NS	NS	NS	NS
	07/15/20	07/22/20	NS	NS	NS	NS
	07/22/20	07/29/20	NS	NS	NS	NS
	07/29/20	08/05/20	NS	NS	NS	NS
	08/05/20	08/12/20	NS	NS	NS	NS
	08/12/20	08/19/20	NS	NS	NS	NS
	08/19/20	08/26/20	NS	NS	NS	NS
	08/26/20	09/02/20	NS	NS	NS	NS
	09/02/20[4]	09/09/20	1.9	0.4	33.6	1.3
	09/09/20*	09/14/20	3.5	0.5	48.3	1.8
	09/14/20*	09/16/20	R[2]	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.3	0.4	34.1	1.7
	09/23/20	09/30/20	1.4	0.3	27.6	1.3
Idaho Falls Dup[5]	07/01/20	07/08/20	NS[3]	NS	NS	NS
	07/08/20	07/15/20	NS	NS	NS	NS
	07/15/20	07/22/20	NS	NS	NS	NS
	07/22/20	07/29/20	NS	NS	NS	NS
	07/29/20	08/05/20	NS	NS	NS	NS
	08/05/20	08/12/20	NS	NS	NS	NS
	08/12/20	08/19/20	NS	NS	NS	NS
	08/19/20	08/26/20	NS	NS	NS	NS
	08/26/20	09/02/20	NS	NS	NS	NS
	09/02/20[4]	09/09/20	1.7	0.3	32.6	1.3
	09/09/20*	09/14/20	3.9	0.5	51.8	1.9
	09/14/20*	09/16/20	R[2]	R	R	R
	09/16/20*	09/18/20	R	R	R	R
	09/18/20*	09/23/20	2.0	0.4	37.3	1.7
	09/23/20	09/30/20	1.7	0.4	29.8	1.3

* Partial week sample.
** Extended week sample (8 days).
[1] Sampler owned and operated by the Shoshone-Bannock Tribes.
[2] R - Result was rejected. Insufficient sample volume for analysis.
[3] NS - No sample. Sampler was out of service for repair/replacement.
[4] New sampler Model HVP-4300VFC was deployed.
[5] Dup – Duplicate sampler at the Idaho Falls location.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, third quarter, 2020.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	10.9	2.5
Craters of the Moon	12.7	2.5
Big Lost River Rest Area	13.1, 15.2	-
Van Buren Avenue	16.0	1.9
Experimental Field Station	10.3	2.1
Main Gate	13.0	2.2
Atomic City	9.4	2.8
Taber	13.5	1.8
Blackfoot	9.2, 13 3	3.0
Ft. Hall	12.0, 13.6	-
Idaho Falls	10.3	3.0
Mud Lake/ Terreton	14.7, 16.1	-
Monteview	15.7, 16.9	-
Sand Dunes	12.9	2.2
Howe Met. Tower	10.3, 10.6	-
MP282 -20	12.1	2.9
MP280 -20	10.6	1.1
MP278 -20	11.5	2.6
MP276 -20	11.2	1.7
MP274 -20	11.6	2.9
MP272 -20	10.2	2.2
MP270 -20	13.2	0.6
MP268 -20	13.4	0.1
MP266 -20	12.4, 12.9	-
MP264 -20	11.1	2.0
MP270 -20/26	12.4	3.5
MP268 -20/26	12.0, 13.9	-
MP266 -20/26	12.5	2.3
MP263 -20/26	13.0, 13.6	3.4
MP261 -20/26	14.8, 15.9	-
MP259 -20/26	11.9	2.3
MP256 -20/26	13.7	0.5
MFC (EBR II)	14.2, 15.3	-
EBR I	12.6, 13.7	-
RWMC	14.3	1.2
CFA	15.9	2.5
CITRC (PBF)	13.4, 13.4	-
INTEC	20.5	2.0
ATR (TRA)	17.6, 18.1	-
NRF	10.2, 12.3	-
TAN/SMC	9.8, 11.4	-
Mud Lake Bank of Commerce	14.6	3.0
MP43-33	14.4	3.3
MP41-33	10.4, 11.7	-
MP39-33	14.5, 15.3	-

Table B.1. continued. Results for all electret ionization chamber (EIC) locations, third quarter, 2020.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP37-33	12.0	2.5
MP35-33	12.8, 14.2	-
MP33-33	15.1, 16.2	-
MP31-33	11.2, 12.9	-
MP29-33	13.5	2.9
MP27-33	12.8	1.8
MP25-33	12.1, 14.1	-
MP23-33	10.4, 10.8	-
MP21-33	10.3, 11.4	-
MP19-33	11.0	2.3
MP14-33	10.3	2.1
MP11-33	12.2	3.4
MP06-33	9.7, 11.3	-
MP03-33	12.8	3.0
Base of Howe	13.8	1.0
Rover	14.3	1.7
Hamer	11.0, 11.3	2.9
Sugar City	15.9	1.2
Roberts	13.7	2.3
Big Southern Butte	13.0	1.3
T4 North	15.3	2.7
T4 South	10.8	2.2

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