

Department of Environmental Quality  
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM  
QUARTERLY DATA REPORT**

**January - March, 2020**



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# Table of Acronyms

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

## Introduction

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

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

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

## Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the first quarter, 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.

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the first quarter of 2020 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide. The MDC for Cs-137 is also reported since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

Annual composites of filters collected using TSP samplers are also analyzed using radiochemical separation techniques. Results from the annual composite analyses are typically presented in the following year's first quarter report. The samples are analyzed for Strontium-90, Plutonium-238, Plutonium-239/240, and Americium-241 (**Table 6**). Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons. DEQ-INL OP's action levels of 19 for Americium-241, 190 for Strontium-90, 21 for Plutonium-238, and 20 for

Plutonium-239/240 (in  $1 \times 10^{-5}$  pCi/m<sup>3</sup>) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation. Results for all locations exceed the <sup>89/90</sup>Sr MDC for the 2019 annual composite. Four results exceed the <sup>238</sup>Pu MDC for the 2019 annual composite at Craters of the Moon, Montevieu, Mud Lake, and Van Buren sampling sites. Eight results exceed the <sup>239/240</sup>Pu MDC for the 2019 annual composite at Atomic City, Craters of the Moon, Experimental Field Station, Fort Hall, Idaho Falls, Mud Lake, Big Lost River Rest Area, and Van Buren sampling sites. One result exceeded the <sup>241</sup>Am MDC for the 2019 annual composite at the Fort Hall sampling site. Though minimally exceeding the MDC, these results are well under the specified regulatory limits and DEQ-INL OP's action levels.

Radioactive iodine samples are collected weekly. Samples are collected by drawing air through a canister filled with activated charcoal using a low-volume air pump. The activated charcoal contained in the canister traps the radioiodine by adsorption onto its porous surface. Each week, canisters are collected from all eleven air monitoring stations and analyzed together as a composite. If Iodine-131 is detected in this grouping, the canisters are individually analyzed. No radioactive isotopes of iodine, specifically Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the first quarter.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. All results are below MDCs and below the DEQ-INL OP action level of 150 pCi/m<sup>3</sup> (40 CFR 61). Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the first quarter of 2020. Precipitation samples were analyzed for tritium and manmade gamma-emitting radionuclides. Reported values were either the result of a single sample or a weighted mean when more than one precipitation sample was collected during the calendar quarter. Tritium and manmade gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the first quarter of 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**.

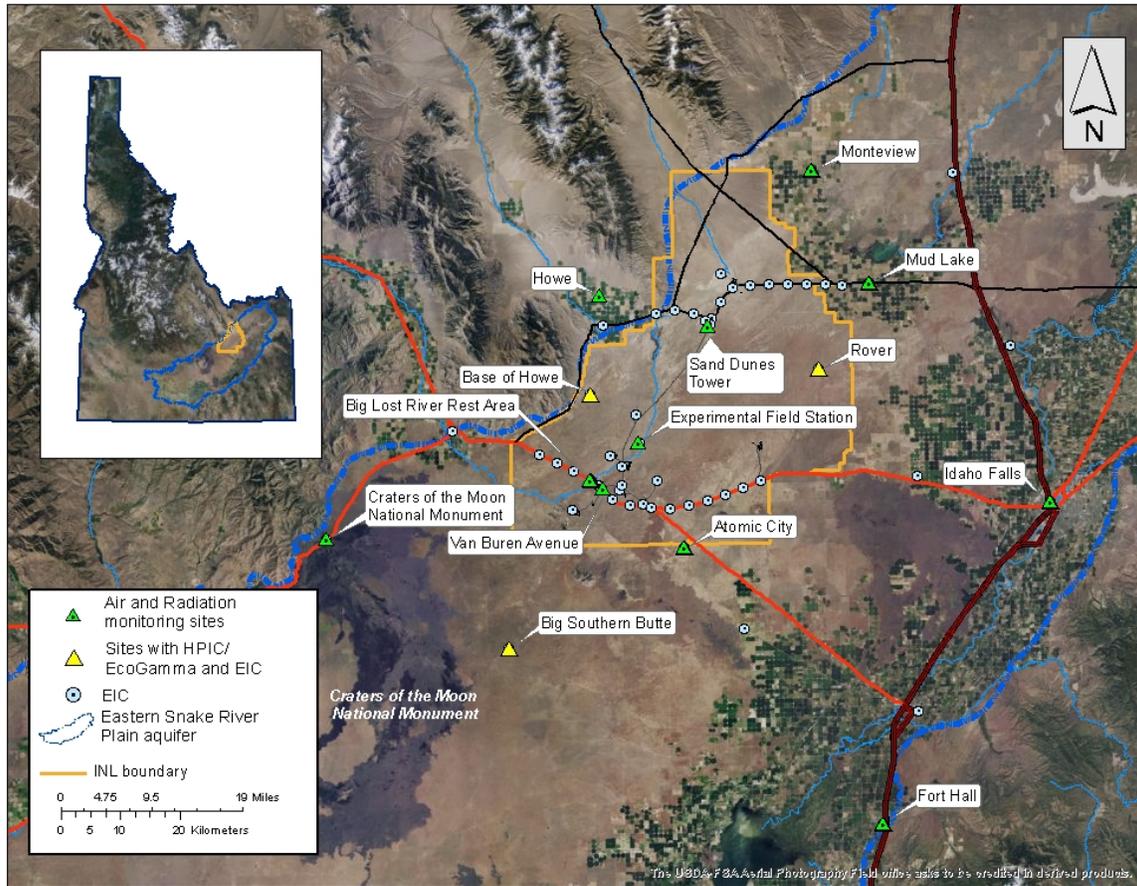


Figure 1. Air and radiation monitoring locations.

**Table 1. Sampling locations and sample type.**

Station Locations	Sample type <sup>1</sup>			
	TSP	Radioiodine	Water Vapor	Precipitation
<b>On-site Locations</b>				
Big Lost River Rest Area	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Experimental Field Station	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Sand Dunes Tower	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Van Buren Avenue	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>Boundary Locations</b>				
Atomic City	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Howe	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monteview	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mud Lake	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Distant Locations</b>				
Craters of the Moon	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Fort Hall <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Idaho Falls	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

<sup>1</sup>  Samples collected weekly;  Samples collected quarterly.

<sup>2</sup> TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

**Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2020.**

Station Location	Concentration					
	Gross Alpha			Gross Beta		
<b>On-Site Locations</b>						
Big Lost River Rest Area	0.3	-	0.9	13.9	-	34.6
Experimental Field Station	0.7	-	2.4	22.9	-	116.1
Sand Dunes Tower	0.2	-	0.6	12.1	-	44.7
Van Buren Avenue	0.6	-	2.6	25.0	-	129.5
<b>Boundary Locations</b>						
Atomic City	0.2	-	1.5	14.1	-	51.2
Howe	0.8	-	1.8	26.6	-	97.1
Monteview	0.4	-	1.0	15.5	-	32.0
Mud Lake	0.3	-	1.7	11.3	-	68.5
<b>Distant Locations</b>						
Craters of the Moon	0.1	-	0.5	5.7	-	20.6
Fort Hall <sup>1</sup>	0.3	-	1.6	10.8	-	42.7
Idaho Falls	0.3	-	1.1	10.5	-	47.5

<sup>1</sup> Operated by Shoshone-Bannock Tribes.

Note: Concentrations are expressed in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>.

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

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides	
	Concentration	± 2 SD	Concentration	MDC
<b>On-site Locations</b>				
Big Lost River Rest Area	95.1	5.0	<MDC <sup>2</sup>	
Experimental Field Station	160.7	8.3	<MDC	
Sand Dunes Tower	64.3	3.6	<MDC	
Van Buren Avenue	172.2	8.9	<MDC	
<b>Boundary Locations</b>				
Atomic City	96.1	5.1	<MDC	
Howe	143.3	7.5	<MDC	
Monteview	66.4	3.7	<MDC	
Mud Lake	65.2	3.6	<MDC	
<b>Distant Locations</b>				
Craters of the Moon	61.8	3.3	<MDC	
Fort Hall <sup>1</sup>	104.8	5.6	<MDC	
Idaho Falls	80.1	4.3	<MDC	

<sup>1</sup>Operated by Shoshone-Bannock Tribes.

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

Note: Concentrations are reported in  $1 \times 10^{-5}$  pCi/m<sup>3</sup> with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

**Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2020.**

Station Location	Tritium		
	Concentration	± 2 SD	MDC
<b>On-site Locations</b>			
Big Lost River Rest Area	0.05	0.11	0.19
Experimental Field Station	0.12	0.16	0.28
Sand Dunes Tower	0.05	0.21	0.38
Van Buren Avenue	0.07	0.22	0.38
<b>Boundary Locations</b>			
Atomic City	0.09	0.25	0.43
Howe	0.04	0.20	0.35
Mud Lake	-0.05	0.20	0.36
Monteview	-0.04	0.16	0.28
<b>Distant Locations</b>			
Craters of the Moon	-0.05	0.20	0.36
Fort Hall <sup>1</sup>	-0.03	0.25	0.45
Idaho Falls	0.01	0.25	0.42

<sup>1</sup>Operated by Shoshone-Bannock Tribes.

Note: Concentrations are reported in pCi/m<sup>3</sup> with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

**Table 5. Tritium and gamma-emitting radionuclide concentrations from precipitation, first quarter, 2020.**

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
<b>On-Site Locations</b>						
Big Lost River Rest Area	100	120	190	0.6	1.2	1.9
<b>Boundary Locations</b>						
Atomic City	40	120	190	1.0	1.2	1.9
Howe	90	120	190	-0.8	1.9	3.3
Monteview	10	120	190	-0.1	1.5	2.6
Mud Lake	60	120	190	0.5	1.2	2.0
<b>Distant Locations</b>						
Idaho Falls	10	120	190	-0.3	1.5	2.7

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

**Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2019.**

Station Location	<sup>90</sup> Sr			<sup>238</sup> Pu			<sup>239/240</sup> Pu			<sup>241</sup> Am		
	Value <sup>1</sup>	±2SD	MDC	Value <sup>1</sup>	± 2SD	MDC	Value <sup>1</sup>	±2SD	MDC	Value <sup>1</sup>	±2SD	MDC
<b>On-Site Locations</b>												
BLR <sup>4</sup> Rest Area	2.39	0.80	0.90	0.03	0.03	0.03	0.03	0.02	0.01	0.01	0.02	0.03
EFS <sup>3</sup>	14.84	3.66	1.57	0.05	0.04	0.06	0.07	0.05	0.06	0.03	0.03	0.04
Sand Dunes	0.90	0.38	0.49	0.02	0.02	0.02	0.02	0.02	0.03	-0.01	0.01	0.03
Van Buren Avenue	11.57	2.89	1.14	0.03	0.02	0.01	0.05	0.02	0.02	0.00	0.02	0.03
<b>Boundary Locations</b>												
Atomic City	4.70	1.29	0.92	0.01	0.01	0.01	0.04	0.02	0.02	0.01	0.02	0.03
Howe	2.88	0.85	0.78	0.01	0.02	0.03	0.02	0.02	0.02	0.00	0.02	0.03
Monteview	3.13	0.95	0.85	0.03	0.02	0.01	0.02	0.03	0.04	0.00	0.02	0.03
Mud Lake	5.00	1.39	1.02	0.03	0.02	0.01	0.06	0.04	0.03	0.01	0.02	0.03
<b>Distant Locations</b>												
Craters of Moon	2.59	0.78	0.74	0.02	0.02	0.01	0.04	0.02	0.01	0.00	0.01	0.03
Fort Hall <sup>2</sup>	1.64	0.90	1.31	0.02	0.03	0.04	0.07	0.04	0.04	0.04	0.02	0.03
Idaho Falls	1.31	0.82	1.23	-0.01	0.02	0.05	0.04	0.03	0.03	0.01	0.02	0.03

Note: Concentrations are reported in  $1 \times 10^{-5}$  pCi/m<sup>3</sup> with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar year.

<sup>1</sup> Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons. DEQ-INL OP's action levels of 19 for americium-241, 190 for strontium-90, 21 for plutonium-238, and 20 for plutonium-239/240 (in  $1 \times 10^{-5}$  pCi/m<sup>3</sup>) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.

<sup>2</sup> Operated by Shoshone-Bannock Tribes.

<sup>3</sup> Experimental Field Station.

<sup>4</sup>BLR – Big Lost River.

## Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the first 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 7**).

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

HPICs 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 8** lists the average radiation exposure rates measured by the HPIC/EcoGammas for first quarter 2020. **Table 9** lists the EIC monitoring results for first quarter 2020. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

**Table 7. Summary of instrumentation at radiation monitoring stations.**

Station Location	Instrument Type	
	HPIC/EcoGamma	EIC
<b>On-site Locations</b>		
Base of Howe	■	■
Big Lost River Rest Area	■	■
Experimental Field Station		■
Rover	■	■
Sand Dunes Tower	■	■
Van Buren Avenue		■
<b>Boundary Locations</b>		
Atomic City	■	■
Big Southern Butte	■	■
Howe Met Tower	■	■
Monteview	■	■
Mud Lake/Terreton	■	■
<b>Distant Locations</b>		
Craters of the Moon		■
Fort Hall	■	■
Idaho Falls	■	■

**Table 8. Average gamma exposure rates, first quarter, 2020, from HPIC/EcoGamma\* network.**

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
<b>On-site Locations</b>		
<sup>1</sup> Base of Howe	-	-
Big Lost River Rest Area	12.3	1.7
<sup>1</sup> Rover	-	-
Sand Dunes Tower	14.4	2.1
<b>Boundary Locations</b>		
Atomic City	11.8	1.8
Big Southern Butte	12.8	1.8
Howe Met Tower	11.6	1.3
Monteview	11.1	1.7
Mud Lake / Terreton	12.2	1.6
<b>Distant Locations</b>		
Fort Hall	12.4	1.4
Idaho Falls	9.0	4.1

<sup>1</sup>No data available for these locations for first quarter 2020 due to electronic malfunctions / failures in instrumentation.

\*The HPICs 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 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2020.**

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average <sup>1</sup>	± 2 SD
<b>On-Site Locations</b>		
Base of Howe	8.9 , 9.7	-
Big Lost River Rest Area	9.7, 10.2	-
Experimental Field Station	9.8	3.2
Rover	10.0	2.6
Sand Dunes Tower	9.0 , 10.3	-
Van Buren Avenue	11.3	2.7
<b>Boundary Locations</b>		
Atomic City	9.6	3.2
Big Southern Butte	9.1	1.2
Howe Met Tower	13.5	1.9
Monteview	6.1	1.3
Mud Lake/Terreton	12.9	2.5
<b>Distant Locations</b>		
Craters of the Moon	9.7	3.5
Fort Hall	10.5	0.3
Idaho Falls	7.9	1.7

<sup>1</sup>Results are the average of triplicate exposure rate measurements with the associated sample variability ( $\pm 2$  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  $\pm 2$  SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.

## Water Monitoring Results

DEQ-INL OP collects groundwater samples from wells and springs located within, upgradient of, and downgradient of the INL in order to evaluate the effects of INL contaminants on water quality in the eastern Snake River Plain (ESRP) aquifer and verify the results of DOE and USGS monitoring. Each year, DEQ-INL OP samples approximately 80-85 locations concurrently with a DOE contractor or the USGS and 15-20 locations independently. Co-sampled locations are primarily on or near the INL Site and are usually sampled during the second and fourth calendar quarters. DEQ-INL OP publishes a comparison of its own analytical results with those obtained by co-samplers in the DEQ-INL Oversight Program Annual Report. Locations sampled independently by DEQ-INL OP are mostly in the Magic Valley and are typically sampled during the third calendar quarter.

Most water samples are collected from wells drilled into the aquifer or springs formed by the intersection of the aquifer water table with the surface. Each aquifer well or spring is categorized as upgradient, facility, boundary, or distant based on its location (**Figure 2** and **Figure 3**):

- *Upgradient* sites are situated north or northeast of INL facilities in areas that have not been affected by INL operations. They are used to monitor background concentrations in the aquifer.
- *Facility* sites are located near facility complexes within the INL, including the Advanced Test Reactor complex (ATR), the Central Facilities Area (CFA), the Idaho Nuclear Technology and Engineering Center (INTEC), the Materials and Fuels Complex (MFC), the Naval Reactors Facility (NRF), the Radioactive Waste Management Complex (RWMC), and Test Area North (TAN). Facility sites are located within or immediately downgradient of known areas of

contamination and are sampled to monitor the concentrations and migration of specific contaminants.

- *Boundary* sites are located near the southern boundary of the INL, downgradient of potential sources of INL contamination. These include several wells equipped with Westbay Multilevel Groundwater Monitoring Systems (“Westbay wells”), which offer a look at the vertical distribution of constituents in the aquifer.
- *Distant* sites are located farther downgradient of the INL, primarily in the Magic Valley, and include wells and springs used for agricultural, municipal, domestic, and industrial purposes.

A small number of samples are also collected each year from streams, waste-pond effluent, and wells drilled into perched groundwater (groundwater that sits above the aquifer).

Samples collected from water-monitoring sites are analyzed for radiological and non-radiological constituents, many of which are present in the aquifer both naturally and as a result of INL operations. All locations are sampled for gross alpha and gross beta radioactivity, manmade gamma-emitting nuclides, tritium, common ions,<sup>1</sup> and nitrate-plus-nitrite.<sup>2</sup> 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 (<sup>234</sup>U, <sup>235</sup>U, and <sup>238</sup>U), plutonium isotopes (<sup>238</sup>Pu, <sup>239/240</sup>Pu), americium-241 (<sup>241</sup>Am), strontium-90 (<sup>90</sup>Sr), and technetium-99 (<sup>99</sup>Tc)—selected trace metals, total phosphorous, and/or volatile organic compounds (VOCs) based on past and present INL operations or a history of elevated concentrations. If unexpected levels of radioactivity are detected in gross measurements, additional samples will be collected and analyzed for specific radionuclides.

During the first quarter of 2020, DEQ-INL OP sampled groundwater at four monitoring locations: one facility aquifer well at INTEC and three perched-groundwater wells at ATR. **Table 10** lists the locations sampled this quarter, including the sample date, co-sampler, well depth, and analyses requested for each location. Analytical results are reported in **Tables 12 through 18** and summarized below. The results of low-level tritium analyses for 12 samples collected in previous quarters are reported in **Table 14** and discussed below.

**Table 11** shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary 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

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<sup>1</sup> The common ions are calcium, magnesium, potassium, sodium, chloride, fluoride, sulfate, and bicarbonate (reported here as alkalinity).

<sup>2</sup> Distant locations Alpheus Spring, Bill Jones Hatchery, Clear Spring, Minidoka Water Supply, and Shoshone Water Supply and upgradient location Mud Lake Water Supply are sampled only for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second and fourth quarters. Samples for common ions, nitrate-plus-nitrate, and other constituents are collected at these locations during the third quarter.

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

No anomalous or unexpected gross alpha or gross beta activity concentrations were measured in the first quarter of 2020. Gross alpha and gross beta radioactivity were detected within background ranges in ICPP-MON-A-166, the only aquifer location sampled this quarter (**Table 12**). The gross beta concentrations at ATR perched groundwater wells sampled this quarter were elevated but consistent with previous measurements. The MCL for gross beta radioactivity is nuclide-dependent; see the Strontium-90 section below for MCL exceedances.

#### *Manmade gamma-emitting radionuclides*

No manmade gamma-emitting radionuclides were detected at any location sampled this quarter. Results for cesium-137 (<sup>137</sup>Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 12**.

#### *Tritium*

Tritium was analyzed by the standard method in samples from all four locations (**Table 13**). An elevated tritium concentration was observed in perched water well USGS-055 near ATR with a concentration of  $880 \pm 140$  pCi/L. This concentration is in an area of known tritium contamination, and is the lowest ever measured in this well.

Samples from this quarter requiring low-level tritium analysis have not yet been analyzed by that method due to a sample backlog. Twelve low-level tritium samples from previous quarters of 2019 were analyzed in this quarter, and the results are reported in **Table 14**. Three samples are from boundary wells, one from RWMC, seven are from distant wells and springs, and one is from the ATR cold waste pond. Four locations exceed background concentrations but are consistent with past results and continue to indicate a decreasing trend. The highest boundary-area concentration reported is  $95 \pm 9.0$  pCi/L at 747 feet below the ground surface in Westbay well USGS-137A.

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

#### *Strontium-90*

Strontium-90 was analyzed from three perched-groundwater wells at ATR (**Table 15**). Concentrations above the MDC were measured at all three locations. Each of these detections is in an area of known <sup>90</sup>Sr contamination and is consistent with past measurements. Concentrations measured at USGS-055 and USGS-070 were above the MCL of 8 pCi/L for <sup>90</sup>Sr ( $20.9 \pm 4.9$  pCi/L and  $14.4 \pm 3.4$  pCi/L, respectively). The results indicate that <sup>90</sup>Sr concentrations in ATR perched-groundwater at these locations are continuing to decline.

#### *Technetium-99*

No locations were sampled for <sup>99</sup>Tc this quarter.

#### *Actinides*

No locations were sampled for actinides this quarter.

#### *Common ions, trace metals, and nutrients*

Common ions (calcium, magnesium, potassium, sodium, chloride, sulfate, alkalinity), selected trace metals (arsenic and chromium), and nutrients (nitrate-plus-nitrite, phosphorous) were analyzed in samples from all locations (**Tables 16, 17, and 18**). All concentrations were consistent with past observations, and all above-background constituent concentrations were in known areas of contamination. USGS-068 continues to show higher levels of calcium, sodium, chloride, sulfate, nitrate+nitrite, and chromium. The sulfate concentration at USGS-068 (409 mg/L) is above the SMCL of 250 mg/L. All other common ions, trace metals, and nutrients were below their MCLs.

*Volatile organic compounds*

No locations were sampled for VOCs this quarter.

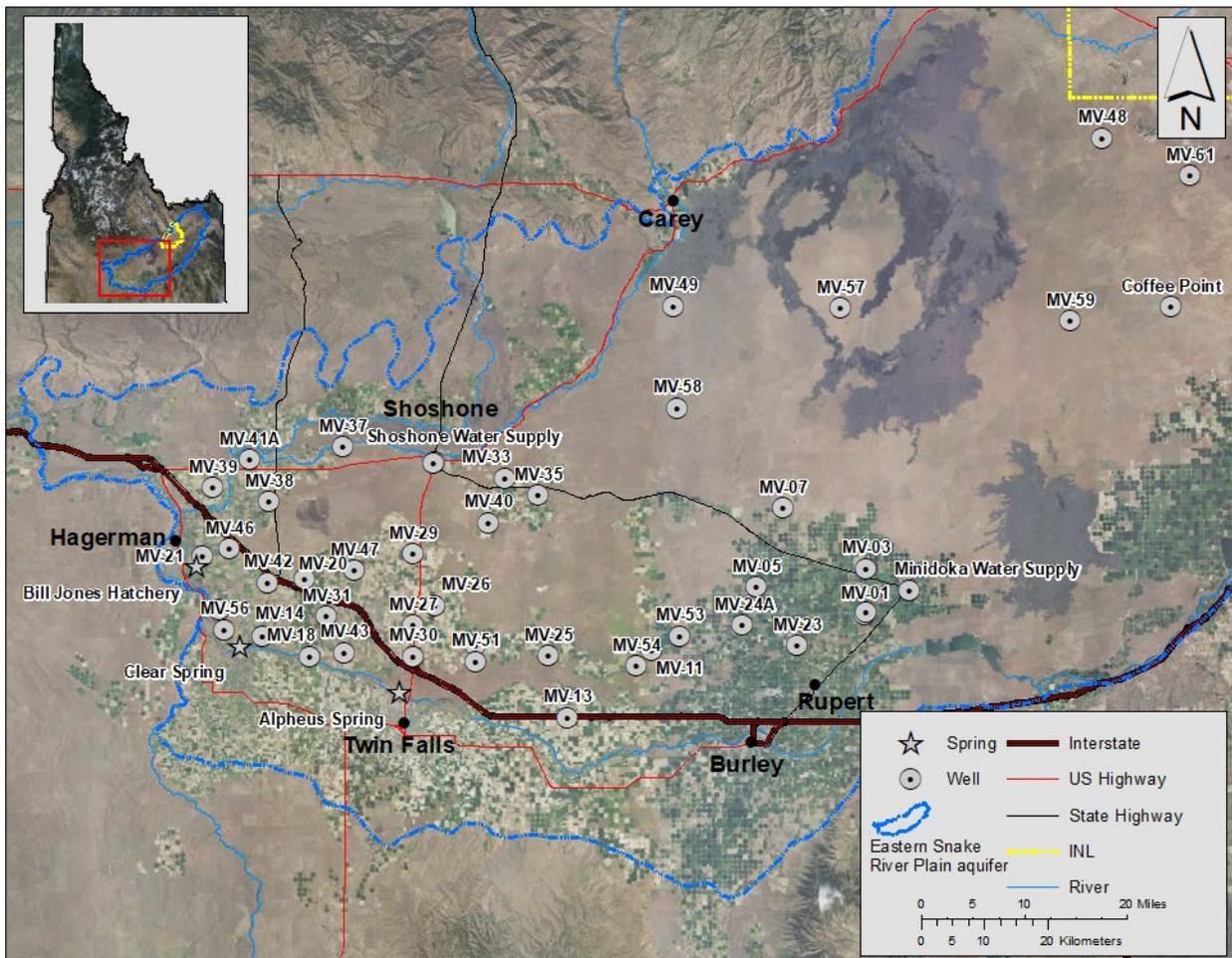


Figure 2. Distant and Surface Water monitoring locations.

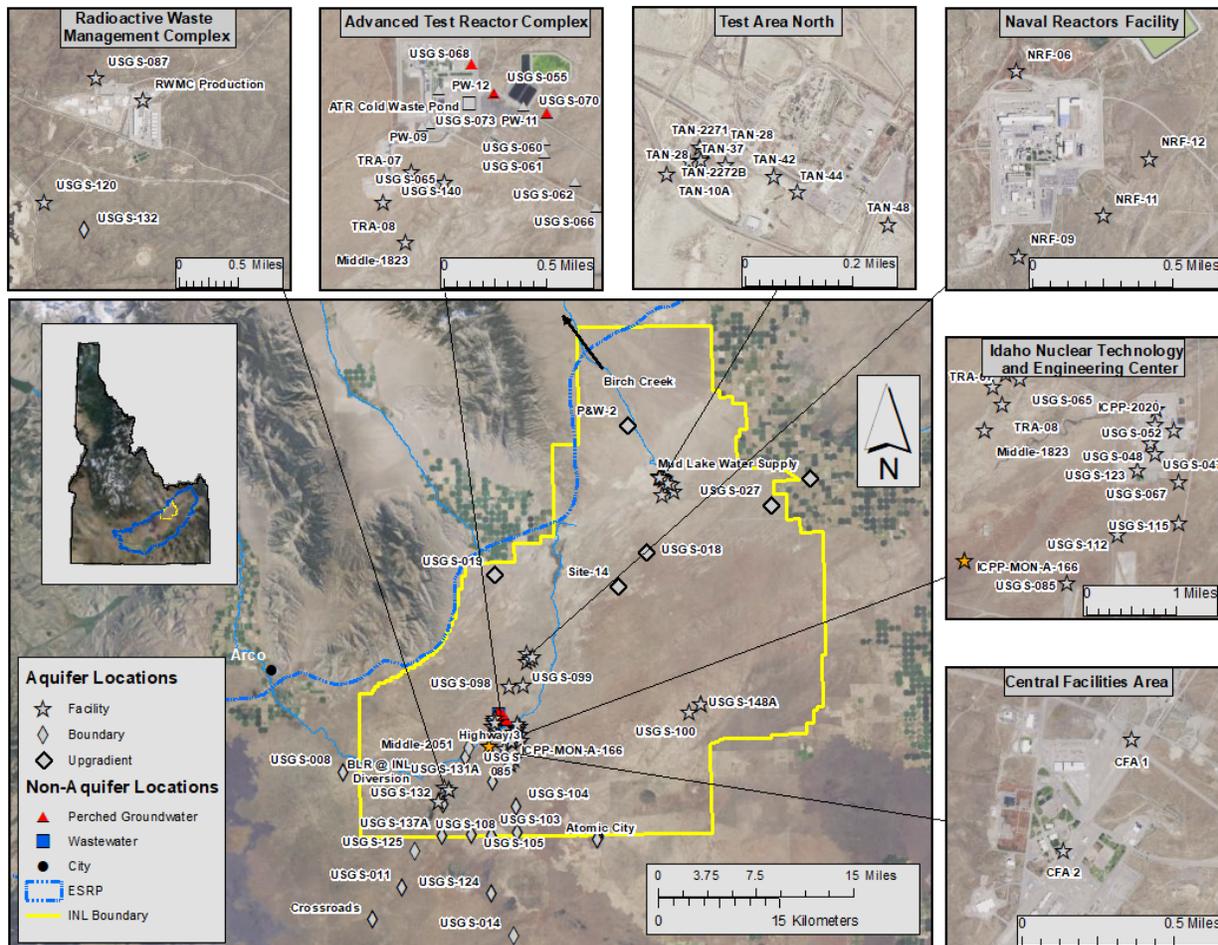


Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), and wastewater monitoring locations.

Table 10. Locations sampled for water, first quarter, 2020.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
<b>Aquifer Samples</b>				
<b>Facility</b>				
<i>Idaho Nuclear Technology and Engineering Center:</i>				
ICPP-MON-A-166	3/30/2020	USGS	527	α, β, γ, <sup>3</sup> H, com. ions, metals, NO <sub>3</sub> +NO <sub>2</sub>
<b>Other Samples</b>				
<b>Perched Groundwater</b>				
<i>Advanced Test Reactor complex:</i>				
USGS-055	3/30/2020	USGS	81	α, β, γ, <sup>3</sup> H, <sup>90</sup> Sr, com. ions, metals, NO <sub>3</sub> +NO <sub>2</sub> , P
USGS-068	3/30/2020	USGS	128	α, β, γ, <sup>3</sup> H, <sup>90</sup> Sr, com. ions, metals, NO <sub>3</sub> +NO <sub>2</sub> , P
USGS-070	3/30/2020	USGS	100	α, β, γ, <sup>3</sup> H, <sup>90</sup> Sr, com. ions, metals, NO <sub>3</sub> +NO <sub>2</sub> , P

\*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; U iso. = <sup>234</sup>U, <sup>235</sup>U, <sup>238</sup>U; Pu iso. = <sup>238</sup>Pu, <sup>239/240</sup>Pu; com. ions = Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, F<sup>-</sup>, alkalinity; metals = As, Ba, Cr, Fe, Pb, Mn, Se, Zn; NO<sub>3</sub>+NO<sub>2</sub> = nitrate plus nitrite, P = total phosphorous.

**Table 11. Constituent background concentration ranges and EPA drinking water standards.**

Constituent	Background <sup>1</sup>	MCL or SMCL <sup>2</sup>
<b>Radiological Constituents (pCi/L)</b>		
Gross alpha	0 - 5.6 <sup>a</sup>	15
Gross beta	0 - 8.6 <sup>a</sup>	4 mrem/yr
Cesium-137	0	200
Tritium	0 - 33 <sup>a</sup>	20,000
Strontium-90	0	8
Technetium-99	0	900
Uranium-234	0.043 - 1.36 <sup>b</sup>	30 µg/L (total U)
Uranium-235	0 - 0.025 <sup>b</sup>	
Uranium-238	0.021 - 0.541 <sup>b</sup>	
Plutonium-238	0	---
Plutonium-239/240	0	---
Americium-241	0	---
<b>Non-radiological Constituents</b>		
<i>Common Ions (mg/L)</i>		
Alkalinity (as CaCO <sub>3</sub> )	75 – 144 <sup>b</sup>	---
Calcium	22.6 – 40.7 <sup>b</sup>	---
Chloride	4.9 – 11.8 <sup>b</sup>	250*
Fluoride	0.1 – 0.2 <sup>b</sup>	4
Magnesium	10.1 – 15.3 <sup>b</sup>	---
Potassium	1.2 – 2.3 <sup>b</sup>	---
Sodium	2.6 – 8.3 <sup>b</sup>	---
Sulfate	9.6 – 21.4 <sup>b</sup>	250*
<i>Trace Metals (µg/L)</i>		
Arsenic	2 – 3 <sup>c</sup>	10
Barium	50 – 70 <sup>c</sup>	2000
Chromium	<1.0 – 5.2 <sup>a</sup>	100
Iron	4 – 16 <sup>d</sup>	300*
Lead	<5 <sup>c</sup>	15
Manganese	<1 – 4 <sup>d</sup>	50*
Selenium	<1 <sup>c</sup>	50
Zinc	<3 – 10.5 <sup>d</sup>	5000*
<i>Nutrients (mg/L)</i>		
Nitrate plus nitrite	<0.04 – 0.655 <sup>b</sup>	10 for NO <sub>3</sub> <sup>-</sup> , 1 for NO <sub>2</sub> <sup>-</sup>
Phosphorous	<0.01 – 0.02 <sup>d</sup>	---
<i>Volatile Organic Compounds (µg/L)</i>		
Tetrachloroethene	0	5
Trichloroethene	0	5
1,1-Dichloroethene	0	7
cis-1,2-dichloroethene	0	70
trans-1,2-dichloroethene	0	100
Vinyl chloride	0	2
Carbon tetrachloride	0	5
Chloroform	0	80 <sup>e</sup>
Chloromethane	0	---
1,1-Dichloroethane	0	---

<sup>1</sup> Sources for background ranges are: <sup>a</sup> DEQ data compiled from distant, boundary, and surface water sites in previous years;

<sup>b</sup> Bartholomay and Hall, 2016 (DOE/ID-22237); <sup>c</sup> Knobel and others, 1992; <sup>d</sup> Knobel and others, 1999 (DOE/ID-22164).

<sup>2</sup> 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. <sup>e</sup> MCL is for total trihalomethanes.

**Table 12. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) in water samples, first quarter, 2020.**

Sample Location	Sample Date	Gross Alpha		Gross Beta		Cesium-137*	
		Concentration	2 SD	Concentration	2 SD	Concentration	2 SD
<b>Aquifer Samples</b>							
<i>Idaho Nuclear Technology and Engineering Center:</i>							
ICPP-MON-A-166	3/30/2020	0.8	0.4	1.8	0.7	0.8	U 1.4
<b>Other Samples</b>							
<b>Perched Groundwater</b>							
<i>Advanced Test Reactor complex:</i>							
USGS-055	3/30/2020	2.4	1.1	66.5	2.1	1.0	U 1.4
USGS-068	3/30/2020	3.0	U 2.1	19.5	2.1	1.7	U 1.7
USGS-070	3/30/2020	1.9	1.0	41.6	1.8	-0.1	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 <sup>137</sup>Cs, the manmade gamma-emitter most likely to be detected in groundwater, are reported in this table.

**Table 13. Tritium concentrations (pCi/L) in water samples, first quarter, 2020.**

Sample Location	Sample Date	Tritium	
		Concentration	2 SD
<b>Aquifer Samples</b>			
<i>Idaho Nuclear Technology and Engineering Center:</i>			
ICPP-MON-A-166	3/30/2020	70	U 120
<b>Other Samples</b>			
<b>Perched Groundwater</b>			
<i>Advanced Test Reactor complex:</i>			
USGS-055	3/30/2020	880	140
USGS-068	3/30/2020	110	U 130
USGS-070	3/30/2020	150	U 130

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

**Table 14. Low-level tritium concentrations (pCi/L) in water samples collected during previous quarters of 2019 and analyzed using the electrolytic enrichment, first quarter 2020.**

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
<b>Aquifer Samples</b>				
<b>Facility</b>				
USGS-120	10/17/2019	69		10
<b>Boundary</b>				
USGS-014	10/17/2019	6	U	6
USGS-125	10/17/2019	44		9
USGS-137A (747 ft bgs)	06/17/2019	95		9
<b>Distant</b>				
Alpheus Spring	08/06/2019	40		9
MV-03	07/16/2019	8	U	5
MV-05	07/16/2019	9		6
MV-07	07/16/2019	13		6
MV-13	07/17/2019	23		8
MV-38	07/17/2019	13		6
MV-56	07/17/2019	0	U	5
<b>Other Samples</b>				
<b>Wastewater</b>				
ATR Cold Waste Pond	11/13/2019	26		10

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

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
<b>Aquifer Samples</b>				
None				
<b>Other Samples</b>				
<b>Perched Groundwater</b>				
<i>Advanced Test Reactor complex:</i>				
USGS-055	3/30/2020	20.9		4.9
USGS-068	3/30/2020	7.9		1.9
USGS-070	3/30/2020	14.4		3.4

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

Sample Location	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity†
<b>Aquifer Samples</b>									
<i>Idaho Nuclear Technology and Engineering Center:</i>									
ICPP-MON-A-166	3/30/2020	36	13	9.5	2.6	-	16	18.7	125
<b>Other Samples</b>									
<b>Perched Groundwater</b>									
<i>Advanced Test Reactor complex:</i>									
USGS-055	3/30/2020	62	18	13	2.9	-	14.4	73.4	161
USGS-068	3/30/2020	170	20	110	2.5	-	69.9	409	215
USGS-070	3/30/2020	64	19	13	3.1	-	15	86.9	156

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<sub>3</sub>.

**Table 17. Dissolved metals concentrations (µg/L) in water samples, first quarter, 2020.**

Sample Location	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
<b>Aquifer Samples</b>									
<i>Idaho Nuclear Technology and Engineering Center:</i>									
ICPP-MON-A-166	3/30/2020	-	-	5.2	-	-	-	-	-
<b>Other Samples</b>									
<b>Perched Groundwater</b>									
<i>Advanced Test Reactor complex:</i>									
USGS-055	3/30/2020	8	-	12	-	-	-	-	-
USGS-068	3/30/2020	<2	U	59	-	-	-	-	-
USGS-070	3/30/2020	8.5	-	7	-	-	-	-	-

Samples were filtered in the field unless otherwise noted.

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

**Table 18. Dissolved nutrient concentrations (mg/L) in water samples, first quarter, 2020.**

Sample Location	Sample Date	Nitrate + Nitrite*	Total Phosphorus
<b>Aquifer Samples</b>			
<i>Idaho Nuclear Technology and Engineering Center:</i>			
ICPP-MON-A-166	3/30/2020	0.29	-
<b>Other Samples</b>			
<b>Perched Groundwater</b>			
<i>Advanced Test Reactor complex:</i>			
USGS-055	3/30/2020	1.3	0.29
USGS-068	3/30/2020	7.4	0.04
USGS-070	3/30/2020	1.3	0.3

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.

# Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants, and provide independent verification of DOE’s terrestrial monitoring programs. Physical soil sampling and *in-situ* gamma spectrometry are used to characterize actual deposition and accumulation of radioactive contaminants in soils. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. No *in-situ* gamma spectroscopic measurements were performed, nor were any soil samples physically collected during the first calendar quarter of 2020.

## Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 (<sup>40</sup>K) and man-made iodine-131 (<sup>131</sup>I). Milk samples are collected on a monthly basis. Results for analyses of milk samples are presented in **Table 19**. <sup>40</sup>K was detected in all samples within the expected range of concentration. <sup>131</sup>I was not detected. Based on measurements of radionuclides in milk, there were no discernable impacts to the off-site environment from INL operations.

**Table 19. Gamma spectroscopy analysis data for milk samples, first quarter, 2020.**

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131 <sup>1</sup>
		Concentration <sup>3</sup>	± 2 SD	
<b>Monitoring Samples</b>				
Astle (Dietrich)	02/04/2020	1474	83	<MDC
Reed’s (Idaho Falls)	02/04/2020	1593	128	<MDC
Minidoka (Rupert)	03/03/2020	1532	124	<MDC
Barzee (Howe)	03/03/2020	1486	84	<MDC
<b>Verification Samples<sup>2</sup></b>				
Minidoka (Rupert)	01/07/2020	1553	126	<MDC
Korn (Terreton)	01/07/2020	1631	70	<MDC

<sup>1</sup> <MDC – Less than Minimum Detectable Concentration (approximately 2 - 8 pCi/L for iodine-131).

<sup>2</sup> DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.

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

## Quality Assurance

Measurements of constituent concentrations in environmental media are subject to inaccuracy from errors that may be introduced during the collection, transportation, and analysis of samples, calibration of equipment, and recording and reporting of results. While it is impossible to quantify every error that may affect a result, a quality assurance (QA) program can evaluate the overall quality of a dataset and, in many cases, identify and address errors or inaccuracies. DEQ-INL OP's QA program is designed to (1) ensure sample integrity, (2) evaluate the precision and accuracy of analytical results, and (3) ensure that the environmental data are representative and complete.

This section summarizes the quality assurance assessment of the data collected by DEQ-INL OP in the first quarter of 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 first quarter of 2020, DEQ-INL OP submitted 48 QC samples for various radiological and non-radiological analyses (**Table 20**).

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

### Blank Samples

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

For all analyses except low-level tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For low-level tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 33 pCi/L.<sup>3</sup> If a blank result exceeds acceptance criteria, above-MDC results in other samples collected, transported, or analyzed together with the failed blank may be qualified as biased high (J+) or rejected (R), or may remain unqualified, depending on the relative sizes of the blank detection and other sample results.

Blank sample results submitted for gross alpha and gross beta screening in air for the first quarter of 2020 are presented in **Table 21**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 22**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 23**. Blank analysis results for radiochemical separation analyses for TSP particulate filters collected during 2019 are presented in **Table 24**. Blank sample results for radiological analytes in groundwater are presented in **Table 25**.

<sup>3</sup> 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.

All blank sample results passed acceptance criteria in the first 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  $\pm 20$  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  $\pm 20$  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 26**.

All duplicate results passed acceptance criteria in the first 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  $100 \pm 25\%$ . If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample may be qualified as low-biased estimates (J-), and below-MDC results may be qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples may be qualified as high-biased estimates (J+), and below-MDC results may be qualified as undetected (U). If the percent recovery of a spiked sample is  $<50\%$  or  $>150\%$ , the results of all associated samples may be qualified as rejected (R), except for sample results below MDC associated with a spiked-sample analysis having a percent recovery  $>150\%$ , in which case the sample result remains qualified as undetected (U). No spiked water samples were analyzed during the first quarter of 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  $100 \pm 25\%$  when compared to the known irradiated quantity. The irradiation results for first quarter 2020 are presented in **Table 27**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. All EIC spiked samples passed the DEQ-INL OP criteria.

## Laboratory QC Issues

There were no laboratory QC issues to report in the first quarter of 2020.

## Analytical QA/QC Assessment

No issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the first quarter of 2020 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 9.6% is slightly less than the DEQ-INL OP requirement of 10%, due primarily to fewer QC water analyses for the quarter. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the first 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 97.2% for the first quarter of 2020 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 20**. The overall data completeness (usable results divided by the total number of field sample results expected) of 94.7% is also acceptable.

## Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. The TSP sampler at the Howe sampling station was down for most of the time from 1/2/20 to 1/14/20. The sampler was replaced on 1/14/20. This sampling station was down and no sample was obtained for the week of 3/18/20 – 3/25/20. The Mud Lake TSP sampler was out of service for repair for the last two weeks of the quarter. No sample was obtained from the Sand Dunes TSP sampler for the week 3/4/20 – 3/11/20 due to equipment issues. Service reliability for air sampling equipment for the first quarter of 2020 is summarized in **Table 28**.

## Conclusion

All data collected for the first quarter of 2020 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 97.2% and data completeness of 94.7% are acceptable for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP, other than the slightly low number of QC analyses performed.

**Table 20. Summary of the analyses performed, first quarter, 2020.**

Media Sampled	Collection Device	Analyte	Sample Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected <sup>1</sup>	Analyzing Lab <sup>2</sup>
<b>Air</b>								
<b>Particulate</b>	4-inch filter	Gross alpha	138	13	0	0	7	ISU-EML
		Gross beta	138	13	0	0	7	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	44	4	0	0	0	ISU Sub
<b>Water Vapor</b>	Desiccant column	Tritium	17	5	0	0	0	ISU-EML
<b>Gaseous</b>	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
<b>Precipitation</b>	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	6	0	0	0	0	ISU-EML
<b>Water</b>								
<b>Groundwater &amp; Surface Water</b>	Grab or composite	Gross alpha	4	0	0	0	0	ISU-EML
		Gross beta	4	0	0	0	0	ISU-EML
		Gamma emitters	4	0	0	0	0	ISU-EML
		Tritium	4	0	0	0	0	ISU-EML
		Low-level tritium	12	2	1	0	0	ISU-EML
		Technetium-99	0	0	0	0	0	ISU Sub
		Radiochemical	3	0	0	0	0	ISU Sub
		Metals	4	0	0	0	0	IBL
		Common Ions	4	0	0	0	0	IBL
Nutrients	4	0	0	0	0	IBL		
Volatile Organics	0	0	0	0	0	IBL		
<b>Terrestrial</b>								
<b>Milk</b>	Grab or composite	Gamma emitters	6	0	0	0	0	ISU-EML
<b>Soil</b>	<i>in situ</i>	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – “puck”	Gamma emitters	0	0	0	0	0	ISU-EML
<b>Radiation</b>								
<b>Ambient</b>	EICs	Gamma Radiation	67	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	9	NA	NA	NA	0	DEQ-INL OP
<b>Total analyses performed</b>			<b>499</b>	<b>38</b>	<b>1</b>	<b>9</b>	<b>14</b>	
<b>Total QC analyses performed (blanks, duplicates, and spikes)</b>			<b>48</b>					
<b>Ratio of total QC analyses to total sample analyses<sup>3</sup></b>			<b>9.6%</b>					
<b>Percentage of data that are useable<sup>4</sup></b>			<b>97.2%</b>					

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

<sup>2</sup> 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.

<sup>3</sup> DEQ-INL OP requires that the number of QC analyses performed be at least 10 percent of the number of sample analyses performed.

<sup>4</sup> 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 21. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2020.**

Collection Period		Corrected volume (m <sup>3</sup> ) <sup>1</sup>	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
01/02/2020	01/08/2020	2050	0.0	0.1	0.0	0.5
01/08/2020	01/15/2020	2050	0.0	0.1	0.0	0.5
01/15/2020	01/22/2020	2050	0.0	0.1	0.0	0.5
01/22/2020	01/29/2020	2050	0.0	0.1	-0.2	0.5
01/29/2020	02/05/2020	2050	0.0	0.1	0.1	0.5
02/05/2020	02/12/2020	2050	0.0	0.1	-0.1	0.5
02/12/2020	02/19/2020	2050	0.0	0.1	-0.6	0.5
02/19/2020	02/26/2020	2050	-0.1	0.1	-0.5	0.5
02/26/2020	03/04/2020	2050	0.1	0.1	0.1	0.5
03/04/2020	03/11/2020	2050	0.1	0.1	-0.4	0.5
03/11/2020	03/18/2020	2050	0.1	0.1	0.2	0.5
03/18/2020	03/25/2020	2050	0.0	0.1	-0.2	0.5
03/25/2020	04/01/2020	2050	0.1	0.1	0.5	0.4

Note: Concentrations and associated uncertainties (± 2 SD) are expressed in 1 x 10<sup>-3</sup> pCi/m<sup>3</sup>.

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

**Table 22. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2020.**

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration <sup>1</sup>	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/18/2020	-5	36	60	13	61	61	-2	8	14
Analysis Date	Cesium-134			Cesium-137					
	Concentration <sup>1</sup>	± 2 SD	MDC	Concentration	± 2 SD	MDC			
04/18/2020	-1	4	8	3	4	6			

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

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

**Table 23. Blank analysis results for tritium in water vapor from air samples, first quarter, 2020.**

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP201ZTR01	4/13/2020	4/13/2020	4/30/2020	-0.04	0.09	0.16
OP201ZTR02	4/13/2020	4/13/2020	4/30/2020	0.01	0.09	0.16
OP201ZTR03	4/13/2020	4/13/2020	4/30/2020	0.10	0.10	0.16
OP201Sink	4/07/2020	4/13/2020	4/30/2020	0.03	0.09	0.16
OP201Fridge	4/07/2020	4/13/2020	4/30/2020	0.00	0.09	0.16

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

**Table 24. Blank analysis results for 2019 TSP annual radiological composites of air filters.**

Location	<sup>90</sup> Sr			<sup>238</sup> Pu			<sup>239</sup> Pu/ <sup>240</sup> Pu			<sup>241</sup> Am		
	Value <sup>1</sup>	± 2 SD	MDC	Value <sup>1</sup>	± 2 SD	MDC	Value <sup>1</sup>	± 2 SD	MDC	Value <sup>1</sup>	± 2 SD	MDC
Blank	-0.03	0.19	0.31	0.00	0.01	0.02	0.00	0.01	0.02	0.00	0.01	0.03

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

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

**Table 25. Blank analysis results (pCi/L) for radiological constituents in water, first quarter, 2020.**

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
<b>Tritium (low-level method)</b>						
191W741	11/5/2019	Field	13	6	10	Yes*
191W513	7/17/2019	Field	21	7	11	Yes*

MDC = minimum detectable concentration.

\*Detections in this range are typical of the deionized water used by DEQ to prepare blank samples.

**Table 26. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, first quarter, 2020.**

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	RPD	R <sub>1</sub> -R <sub>2</sub>	3(S <sub>1</sub> <sup>2</sup> +S <sub>2</sub> <sup>2</sup> ) <sup>1/2</sup>	Within Criteria?
<b>Tritium (low-level method)</b>										
MV-03	191W466	8	5	191W472	3	5	91	5	11	Yes

**Table 27. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2020.**

Electret #	Exposure Received		Net Measured Exposure <sup>1</sup>		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SJR363	41.3	2.1	40.2	1.4	97.4%	Y
SJE095	41.3	2.1	34.8	1.3	84.4%	Y
SKR364	41.3	2.1	38.3	1.3	92.8%	Y
<b>Triplicate AVG:</b>					<b>91.5</b>	<b>Y</b>
SKR317	30.0	1.5	28.1	1.4	93.5%	Y
SJE199	30.0	1.5	26.0	1.3	86.5%	Y
SJE062	30.0	1.5	26.5	1.3	88.4%	Y
<b>Triplicate AVG:</b>					<b>89.5%</b>	<b>Y</b>
SJE083	19.9	1.0	17.8	1.3	89.5%	Y
SKR385	19.9	1.0	16.9	1.4	85.0%	Y
SJX074	19.9	1.0	16.2	1.3	81.6%	Y
<b>Triplicate AVG:</b>					<b>85.4%</b>	<b>Y</b>

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

<sup>1</sup> Net measured exposure estimate includes a correction for atmospheric pressure.

**Table 28. Air sampling field equipment service reliability (percent operational), first quarter, 2020.**

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
<b>Onsite Locations</b>				
Big Lost River Rest Area	100%	100%	100%	100%
Experimental Field Station	100%	100%	100%	NC <sup>1</sup>
Sand Dunes Tower	92%	100%	100%	NC <sup>1</sup>
Van Buren Avenue	100%	100%	100%	NC <sup>1</sup>
<b>Boundary Locations</b>				
Atomic City	100%	100%	100%	100%
Howe	77%	100%	100%	100%
Monteview	100%	100%	100%	100%
Mud Lake	85%	100%	100%	100%
<b>Distant Locations</b>				
Craters of the Moon	100%	100%	100%	NC <sup>1</sup>
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.

<sup>1</sup> NC = Sample not collected at this location.

## Appendix A

**Table A-1. Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2020.**

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
<b>On-Site Locations</b>						
<b>Big Lost River Rest Area</b>	01/02/20	01/08/20	0.5	0.2	27.6	1.1
	01/08/20	01/15/20	0.3	0.1	13.9	0.8
	01/15/20	01/22/20	0.5	0.2	27.2	1.0
	01/22/20	01/29/20	0.5	0.2	32.5	1.1
	01/29/20	02/05/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	02/05/20	02/12/20	0.6	0.2	26.7	1.0
	02/12/20	02/19/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	02/19/20	02/26/20	0.7	0.2	34.6	1.1
	02/26/20	03/04/20	0.6	0.2	34.0	1.1
	03/04/20	03/11/20	0.9	0.2	27.0	1.0
	03/11/20	03/18/20	0.8	0.2	25.3	1.1
	03/18/20	03/25/20	0.7	0.2	30.2	1.2
	03/25/20	04/01/20	0.4	0.2	15.9	0.9
<b>Experimental Field Station</b>	01/02/20	01/08/20	1.7	0.3	97.5	2.2
	01/08/20	01/15/20	1.1	0.3	50.6	1.5
	01/15/20	01/22/20	NS <sup>2</sup>	NS <sup>2</sup>	NS <sup>2</sup>	NS <sup>2</sup>
	01/15/20	01/29/20	1.9	0.2	104.6	1.6
	01/29/20	02/05/20	1.1	0.3	60.6	1.6
	02/05/20	02/12/20	1.8	0.3	89.1	2.0
	02/12/20	02/19/20	2.4	0.3	116.1	2.2
	02/19/20	02/26/20	2.0	0.3	102.6	2.1
	02/26/20	03/04/20	1.6	0.3	106.0	2.1
	03/04/20	03/11/20	1.7	0.3	67.2	1.7
	03/11/20	03/18/20	0.9	0.3	31.3	1.5
	03/18/20	03/25/20	0.7	0.2	32.3	1.2
	03/25/20	04/01/20	1.2	0.2	22.9	1.1
<b>Sand Dunes Tower</b>	01/02/20	01/08/20	0.5	0.2	31.1	1.3
	01/08/20	01/15/20	0.4	0.2	17.7	0.9
	01/15/20	01/22/20	0.5	0.2	23.9	1.1
	01/22/20	01/29/20	0.3	0.2	25.4	1.1
	01/29/20	02/05/20	0.2	0.2	16.4	0.9
	02/05/20	02/12/20	0.5	0.2	25.4	1.1
	02/12/20	02/19/20	0.5	0.2	34.4	1.2
	02/19/20	02/26/20	0.4	0.3	44.7	1.7
	02/26/20	03/04/20	0.6	0.2	33.4	1.2
	03/04/20	03/11/20	NS <sup>3</sup>	NS <sup>3</sup>	NS <sup>3</sup>	NS <sup>3</sup>
	03/11/20	03/18/20	0.6	0.2	20.9	1.0
	03/18/20	03/25/20	0.6	0.2	30.7	1.2
	03/25/20	04/01/20	0.4	0.2	12.1	0.8

<sup>1</sup>R – Results rejected. Insufficient sample volume for valid analysis.

<sup>2</sup>NS – No sample. Experimental Field Station was inaccessible on 01/22/20. The week 3 filter collected sample from 01/15/20 to 01/29/20.

<sup>3</sup>NS – No sample. Equipment malfunction resulted in no elapsed sampling time or total air volume sampled.

**Table A-1 continued. Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2020.**

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	01/02/20	01/08/20	1.2	0.3	66.8	1.9
	01/08/20	01/15/20	0.6	0.2	25.0	1.1
	01/15/20	01/22/20	0.8	0.2	60.6	1.6
	01/22/20	01/29/20	1.1	0.2	70.3	1.8
	01/29/20	02/05/20	0.8	0.2	51.5	1.5
	02/05/20	02/12/20	0.9	0.2	56.0	1.6
	02/12/20	02/19/20	1.2	0.3	73.2	1.8
	02/19/20	02/26/20	2.6	0.5	129.5	3.0
	02/26/20	03/04/20	1.4	0.3	72.7	1.8
	03/04/20	03/11/20	0.9	0.2	35.7	1.3
	03/11/20	03/18/20	1.2	0.3	32.7	1.5
	03/18/20	03/25/20	1.9	0.3	60.9	1.7
	03/25/20	04/01/20	1.2	0.2	40.5	1.4
<b>Boundary Locations</b>						
Atomic City	01/02/20	01/08/20	1.5	0.3	34.9	1.4
	01/08/20	01/15/20	0.2	0.2	14.1	0.9
	01/15/20	01/22/20	0.5	0.2	28.7	1.2
	01/22/20	01/29/20	0.9	0.2	41.2	1.4
	01/29/20	02/05/20	0.6	0.2	29.0	1.2
	02/05/20	02/12/20	0.8	0.2	34.5	1.3
	02/12/20	02/19/20	1.0	0.2	42.9	1.4
	02/19/20	02/26/20	0.8	0.2	51.2	1.5
	02/26/20	03/04/20	0.7	0.2	39.7	1.4
	03/04/20	03/11/20	1.1	0.2	33.4	1.3
	03/11/20	03/18/20	0.8	0.2	24.3	1.1
	03/18/20	03/25/20	0.6	0.2	25.1	1.1
	03/25/20	04/01/20	0.7	0.2	16.1	0.9
Howe	01/02/20	01/08/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	01/08/20	01/15/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	01/15/20	01/22/20	1.0	0.2	42.6	1.4
	01/22/20	01/29/20	1.1	0.3	68.4	1.7
	01/29/20	02/05/20	1.1	0.3	53.1	1.5
	02/05/20	02/12/20	1.4	0.3	79.3	1.9
	02/12/20	02/19/20	1.8	0.3	97.1	2.1
	02/19/20	02/26/20	1.8	0.3	74.1	1.8
	02/26/20	03/04/20	1.4	0.3	80.0	1.9
	03/04/20	03/11/20	1.6	0.3	66.4	1.9
	03/11/20	03/18/20	0.8	0.2	26.6	1.2
	03/18/20	03/25/20	NS <sup>2</sup>	NS <sup>2</sup>	NS <sup>2</sup>	NS <sup>2</sup>
	03/25/20	04/01/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>

<sup>1</sup>R – Results rejected. Insufficient sample volume for valid analysis.

<sup>2</sup>NS – No sample. Howe sampling station down due to power issues.

**Table A-1 continued. Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2020.**

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
<b>Montevieu</b>	01/02/20	01/08/20	0.5	0.2	26.8	1.2
	01/08/20	01/15/20	0.5	0.2	21.1	1.1
	01/15/20	01/22/20	0.4	0.2	24.7	1.2
	01/22/20	01/29/20	0.4	0.2	31.9	1.3
	01/29/20	02/05/20	0.4	0.2	16.8	1.0
	02/05/20	02/12/20	0.5	0.2	25.0	1.2
	02/12/20	02/19/20	0.7	0.2	32.0	1.3
	02/19/20	02/26/20	0.6	0.2	30.4	1.3
	02/26/20	03/04/20	0.7	0.2	30.9	1.3
	03/04/20	03/11/20	0.8	0.2	22.0	1.1
	03/11/20	03/18/20	1.0	0.3	29.9	1.5
	03/18/20	03/25/20	0.7	0.2	26.6	1.1
	03/25/20	04/01/20	0.7	0.2	15.5	0.9
<b>Mud Lake</b>	01/02/20	01/08/20	0.6	0.2	42.8	1.6
	01/08/20	01/15/20	0.6	0.2	29.4	1.2
	01/15/20	01/22/20	0.7	0.2	34.6	1.3
	01/22/20	01/29/20	0.7	0.2	42.6	1.5
	01/29/20	02/05/20	0.6	0.2	28.5	1.2
	02/05/20	02/12/20	0.7	0.2	32.9	1.3
	02/12/20	02/19/20	1.7	0.3	68.5	1.7
	02/19/20	02/26/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	02/26/20	03/04/20	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	03/04/20	03/11/20	0.8	0.2	27.2	1.2
	03/11/20	03/18/20	0.3	0.1	11.3	0.8
	03/18/20	03/25/20	NS <sup>2</sup>	NS	NS	NS
	03/25/20	04/01/20	NS <sup>2</sup>	NS	NS	NS
<b>Distant Locations</b>						
<b>Craters of the Moon</b>	01/02/20	01/08/20	0.2	0.2	11.5	0.9
	01/08/20	01/15/20	0.2	0.2	5.7	0.7
	01/15/20	01/22/20	0.3	0.2	11.9	0.8
	01/22/20	01/29/20	0.2	0.2	13.1	0.9
	01/29/20	02/05/20	0.1	0.2	10.6	0.8
	02/05/20	02/12/20	0.2	0.1	8.2	0.7
	02/12/20	02/19/20	0.3	0.2	14.7	0.9
	02/19/20	02/26/20	0.5	0.2	20.6	1.0
	02/26/20	03/04/20	0.3	0.2	13.5	0.9
	03/04/20	03/11/20	0.4	0.2	13.9	0.9
	03/11/20	03/18/20	0.5	0.2	15.7	0.9
	03/18/20	03/25/20	0.4	0.2	18.3	1.0
	03/25/20	04/01/20	0.4	0.2	10.2	0.8

<sup>1</sup>R – Result rejected. Insufficient sample for valid analysis.

<sup>2</sup>NS – No sample. Sampler down for repair.

**Table A-1 continued. Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2020.**

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
<b>Fort Hall<sup>1</sup></b>	01/02/20	01/08/20	0.3	0.2	22.9	1.2
	01/08/20	01/15/20	0.3	0.2	10.8	0.8
	01/15/20	01/22/20	0.8	0.2	32.0	1.3
	01/22/20	01/29/20	0.7	0.2	28.3	1.2
	01/29/20	02/05/20	0.5	0.2	20.4	1.0
	02/05/20	02/12/20	0.5	0.2	15.0	0.9
	02/12/20	02/19/20	1.1	0.3	30.0	1.2
	02/19/20	02/26/20	1.5	0.3	42.7	1.4
	02/26/20	03/04/20	1.0	0.2	33.4	1.2
	03/04/20	03/11/20	1.1	0.2	29.4	1.2
	03/11/20	03/18/20	1.6	0.3	31.1	1.2
	03/18/20	03/25/20	0.8	0.2	34.0	1.3
	03/25/20	04/01/20	0.9	0.2	24.4	1.1
<b>Idaho Falls</b>	01/02/20	01/08/20	0.4	0.2	28.7	1.3
	01/08/20	01/15/20	0.3	0.2	10.5	0.8
	01/15/20	01/22/20	0.6	0.2	28.3	1.2
	01/22/20	01/29/20	0.5	0.2	39.4	1.4
	01/29/20	02/05/20	0.5	0.2	25.9	1.1
	02/05/20	02/12/20	0.6	0.2	26.6	1.1
	02/12/20	02/19/20	0.9	0.2	41.0	1.4
	02/19/20	02/26/20	1.1	0.3	47.5	1.5
	02/26/20	03/04/20	0.9	0.2	35.8	1.3
	03/04/20	03/11/20	0.8	0.2	22.4	1.1
	03/11/20	03/18/20	0.6	0.2	22.4	1.1
	03/18/20	03/25/20	0.8	0.2	27.2	1.2
	03/25/20	04/01/20	0.6	0.2	18.0	1.0

<sup>1</sup>Sampler owned and operated by the Shoshone Bannock-Tribes.

## Appendix B

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

Sample Location	Net Corrected Exposure Rate ( $\mu\text{R/hr}$ ) <sup>1</sup>	$\pm 2$ SD ( $\mu\text{R/hr}$ )
Arco	11.9 , 13.7	-
Craters of the Moon	9.7	3.5
Big Lost River Rest Area	9.7, 10.2	-
Van Buren Avenue	11.3	2.7
Experimental Field Station	9.8	3.2
Main Gate	12.7	2.2
Atomic City	9.6	3.2
Taber	7.4 , 9.5	-
Blackfoot	9.3	2.3
Ft. Hall	10.5	0.3
Idaho Falls	7.9	1.7
Mud Lake/ Terreton	12.9	2.5
Monteview	6.1	1.3
Sand Dunes	9.0 , 10.3	-
Howe Met. Tower	13.5	1.9
MP282 -20	11.7	3.0
MP280 -20	8.0	0.3
MP278 -20	8.7	1.9
MP276 -20	7.5	3.4
MP274 -20	5.9 , 6.4	-
MP272 -20	8.8	3.0
MP270 -20	9.0	1.9
MP268 -20	9.9	0.9
MP266 -20	7.7 , 9.0	-
MP264 -20	11.4	2.7
MP270 -20/26	9.8	1.4
MP268 -20/26	10.7	2.0
MP266 -20/26	13.0	3.4
MP263 -20/26	10.7	2.3
MP261 -20/26	8.2	1.8
MP259 -20/26	8.7	2.8
MP256 -20/26	8.2 , 10.2	-
MFC (EBR II)	9.3	0.2
EBR I	8.9 , 12.9	-
RWMC	9.5	0.1
CFA	11.9	1.7
CITRC (PBF)	10.0	1.3
INTEC	16.3 , 16.9	-
ATR (TRA)	8.6 , 10.0	-
NRF	11.6	1.7
TAN/SMC	7.7 , 8.3	-
Mud Lake Bank of Commerce	8.7	1.9
MP43-33	8.8	1.0
MP41-33	8.4 , 11.3	-
MP39-33	12.1	3.1
MP37-33	10.3	1.5
MP35-33	11.7	2.1
MP33-33	8.8	2.7
MP31-33	7.9	1.0
MP29-33	8.5	2.1

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

Sample Location	Net Corrected Exposure Rate ( $\mu\text{R/hr}$ ) <sup>1</sup>	$\pm 2$ SD ( $\mu\text{R/hr}$ )
MP27-33	23.8	2.2
MP25-33	6.2	2.5
MP23-33	9.3	2.0
MP21-33	7.3	2.2
MP19-33	10.6	2.9
MP14-33	6.8	1.4
MP11-33	6.8 , 6.8	-
MP06-33	9.1 , 9.6	-
MP03-33	8.1	1.5
Base of Howe	8.9 , 9.7	-
Rover	10.0	2.6
Hamer	11.2	2.8
Sugar City	11.5	3.0
Roberts	10.0	2.0
Big Southern Butte	9.1	1.2
T4 North	15.4	1.5
T4 South	8.1 , 8.3	-

<sup>1</sup>Results are the average of triplicate exposure rate measurements with the associated sample variability ( $\pm 2$  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  $\pm 2$  SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.