Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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Table of Contents

Table of Acronyms v
Introduction 1
Air and Precipitation Monitoring Results 1
Environmental Radiation Monitoring Results 6
Water Monitoring Results 8
Terrestrial Monitoring Results 15
Quality Assurance 16

List of Tables

Table 1. Sampling locations and sample type 3
Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2016. 4
Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2016. 4
Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2016 5
Table 5. Tritium and Cesium-137 concentrations from precipitation, first quarter, 2016 5
Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2015. 6
Table 7. Summary of instrumentation at radiation monitoring stations. 7
Table 8. Average gamma exposure rates, first quarter, 2016, from HPIC network. 7
Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2016. 8
Table 10. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations for water samples, first quarter, 2016. 12
Table 11. Reported concentrations of plutonium isotopes in water samples, first quarter, 2016. 12
Table 12. Reported concentrations of uranium isotopes in water samples, first quarter, 2016. 12
Table 13. Reported concentrations of americium-241 in water samples, first quarter, 2016. 12
Table 14. Reported concentrations of strontium-90 in water samples, first quarter, 2016. 12
Table 15. Reported concentrations of technetium-99 in water samples, first quarter, 2016. 13
Table 16. Tritium concentrations for water samples, first quarter, 2016. 13
Table 17. Enriched tritium concentrations for water samples from previous sampling quarters. 13
Table 18. Reported metals concentrations in water samples, first quarter, 2016. 14
Table 19. Reported common ion concentrations in water samples, first quarter, 2016. 14
Table 20. Reported nutrient concentrations in water samples, first quarter, 2016. 14
Table 21. Gamma spectroscopy analysis data for milk samples, first quarter, 2016. 15
Table 22. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, first quarter, 2016. 19
Table 23. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2016. 20
Table 24. Blank analysis results for gamma spectroscopy for TSP particulate air filters, first quarter, 2016. 20
Table 25. Blank analysis results for tritium in water vapor from air samples, first quarter, 2016. 20
Table 27. Radiological blank analysis results in groundwater and/or surface water, first quarter, 2016. 21
Table 28. Blank analysis results (µg/L) for metals in groundwater and/or surface water, first quarter, 2016. 22
Table 29. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, first quarter, 2016. 22
Table 30. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, first quarter, 2016. 22
Table 31. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2016. 22
Table 32. Air sampling field equipment service reliability (percent operational), first quarter, 2016. 23
Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2016 24
Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2016. 28

List of Figures

Figure 1. Air and radiation monitoring sites. 3
Figure 2. Distant and Surface Water monitoring locations. 10
Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations. 11

Table of Acronyms

aCi/L	-	attocuries per liter
ATR	-	Advanced Test Reactor
BEA	-	Battelle Energy Alliance, LLC
BLR	-	Big Lost River
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act
CFA	-	Central Facilities Area
CFR	-	Code of Federal Regulations
CITRC	-	Critical Infrastructure Test Range Complex
CWI	-	CH2M-WG Idaho, LLC
DEQ-INL OP	-	The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program
DOE	-	U.S. Department of Energy
EBR I & II	-	Experimental Breeder Reactors I & II
EFS	-	Experimental Field Station
EIC	-	electret ionization chamber
EML	-	Environmental Monitoring Laboratory
EPA	-	Environmental Protection Agency
ESER	-	Environmental Surveillance, Education and Research Program
ESP	-	Environmental Surveillance Program
ESRPA	-	Eastern Snake River Plain Aquifer
ftbls	-	feet below land surface
GSS	-	Gonzales-Stoller Surveillance, LLC
HPIC	-	high-pressure ion chamber
IBL	-	Idaho Bureau of Laboratories
ICPP	-	Idaho Chemical Processing Plant
IDL	-	instrument detection limit
INL	-	Idaho National Laboratory
INTEC	-	Idaho Nuclear Technology and Engineering Center
ISU	-	Idaho State University
LLD	-	lower limit of detection
LSC	-	liquid scintillation counting
MCL	-	maximum contaminant level
MDA	-	minimum detectable activity
MDC	-	minimum detectable concentration
MFC	-	Materials and Fuels Complex
µg/L	-	micrograms per liter
mg/L	-	milligrams per liter
MP	-	milepost
mrem	-	millirem or 1/1000th of a rem
mR	-	milliRoentgen
mR/hr	-	milliRoentgen per hour
µR/hr	-	microRoentgen per hour
MV	-	Magic Valley
NIST	-	National Institute of Standards and Technology
nCi/L	-	nanocuries per liter
NCRP	-	National Council on Radiation Protection and Measurements
NOAA	-	National Oceanic and Atmospheric Administration
NRF	-	Naval Reactors Facility
PBF	-	Power Burst Facility
pCi/g	-	picocuries per gram
pCi/L	-	picocuries per liter
pCi/m^3	-	picocuries per cubic meter
QAPP	-	Quality Assurance Program Plan
QA/QC	-	Quality Assurance/Quality Control
RCRA	-	Resource Conservation and Recovery Act
RPD	-	relative percent difference
RTC	-	Reactor Technology Complex
RWMC	-	Radioactive Waste Management Complex
SD	-	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 to those who wish to "see the numbers." 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, 2016 (**Figure 1**). These stations employed instrumentation for collecting airborne particulate matter, gaseous radioiodine, precipitation, and water vapor for tritium analysis (**Table 1**). The Shoshone-Bannock Tribes operated an air monitoring station located at Fort Hall. The Fort Hall station uses identical instrumentation and sampling protocol as the ten stations operated by the ESP. The DEQ-INL OP reports the Fort Hall station data as an additional distant site.

Airborne particulate matter was sampled using high-volume total suspended particulate (TSP) air samplers. Starting in the first quarter of 2013 a new sampler (HVP 4304) is operating side by side at Idaho Falls air station with the current sampler (HVP 3804). The new sampler (HVP 4304) is being operated to test dependability and durability under field conditions. Weekly gross alpha and gross beta particulate radioactivity results for filters from the TSP samplers are presented in **Appendix A** and summarized as a range of results in **Table 2**. Results are within the expected historical range.

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the first quarter of 2016 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

Annual composites of filters collected using TSP samplers are also analyzed using radiochemical separation techniques. Results from the annual composite analyses are typically presented in the following year's first quarter report. The samples are analyzed for Strontium-90, Plutonium-238,

Plutonium-239/240, and Americium-241 **(Table 6).** Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons. DEQ-INL's action levels of 190 for Americium-241, 1900 for Strontium-90, 210 for Plutonium-238, and 200 for Plutonium-239/240 (in 1 x 10^{-6} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation. Results exceeding MDC for the 2015 annual composites are as follows: the Howe and Sand Dunes samples exceeded MDC for ^{238}Pu; and Atomic City, Howe, Rest Area, and Sand Dunes samples exceeded MDC for $^{239/240}$Pu. Though minimally exceeding the MDC, the results are well under the specified regulatory limits and DEQ-INL OP's action levels.

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

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. Atmospheric tritium was detected above the minimum detectable concentration (MDC) during the first quarter of 2016 at the Howe and Idaho Falls sampling stations. There is one individual sample within the weighted mean that exceeded MDC located at the Sand Dunes sampling site: 0.16 pCi/m^3 (MDC 0.10 pCi/m^3).While the results are above MDC they are still well below the DEQ-INL OP action level of 150 pCi/m^3 (40 CFR 61).Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the first quarter of 2016. Precipitation samples were analyzed for tritium and gamma-emitting radionuclides. Reported values were either the result of a single sample or a weighted mean when more than one precipitation sample was collected during the calendar quarter. Tritium and gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the first quarter of 2016. Tritium and Cesium-137 analysis results are presented in **Table 5**.

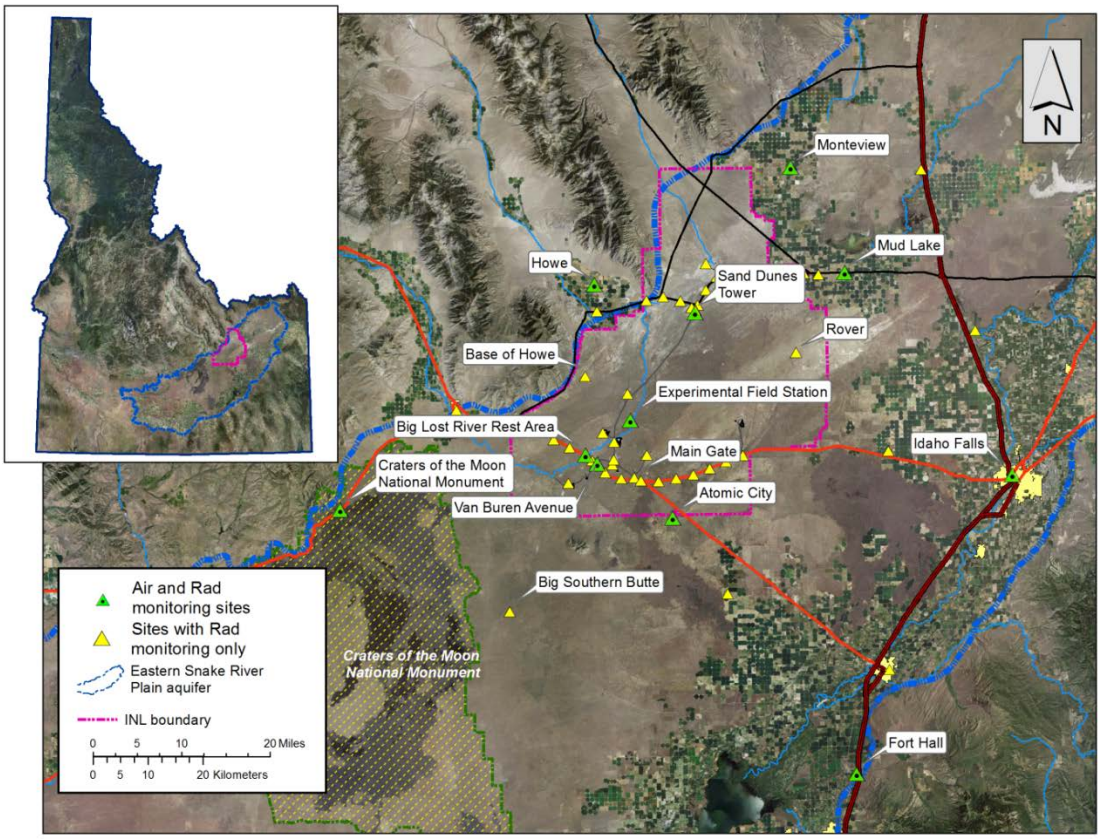

Figure 1. Air and radiation monitoring sites.

Table 1. Sampling locations and sample type

Station Locations	Sample type[1]			
	TSP	Radioiodine	Water Vapor	Precipitation
On-site Locations				
Big Lost River Rest Area	□	□	■	■
Experimental Field Station	□	□	■	
Sand Dunes Tower	□	□	■	
Van Buren Avenue	□	□	■	
Boundary Locations				
Atomic City	□	□	■	■
Howe	□	□	■	■
Monteview	□	□	■	■
Mud Lake	□	□	■	■
Distant Locations				
Craters of the Moon	□	□	■	
Fort Hall[2]	□	□	■	
Idaho Falls	□	□	■	■

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

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2016.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.2	-	1.1	11.8	-	66.0
Experimental Field Station	0.3	-	1.2	10.7	-	68.5
Sand Dunes Tower	0.2	-	1.2	8.6	-	65.3
Van Buren Avenue	0.3	-	1.1	9.0	-	53.1
Boundary Locations						
Atomic City	0.2	-	1.2	11.3	-	63.0
Howe	0.0	-	1.1	9.1	-	53.8
Monteview	0.3	-	1.3	9.7	-	65.3
Mud Lake	0.5	-	1.9	15.9	-	86.7
Distant Locations						
Craters of the Moon	0.1	-	0.5	6.5	-	31.0
Fort Hall[1]	0.3	-	0.9	8.2	-	34.5
Idaho Falls – HVP 3804	0.4	-	1.4	14.0	-	61.8
Idaho Falls – HVP 4304	0.4	-	1.4	13.6	-	59.1

[1]Operated by Shoshone-Bannock Tribes.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2016.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides	
	Concentration	± 2 SD	Concentration	MDC
On-site Locations				
Big Lost River Rest Area	52.0	2.9	<MDC[2]	
Experimental Field Station	45.8	2.6	<MDC	
Sand Dunes Tower	37.6	2.1	<MDC	
Van Buren Avenue	37.7	2.2	<MDC	
Boundary Locations				
Atomic City	42.1	2.4	<MDC	
Howe	39.4	2.3	<MDC	
Monteview	42.8	2.4	<MDC	
Mud Lake	59.4	3.2	<MDC	
Distant Locations				
Craters of the Moon	53.1	3.0	<MDC	
Fort Hall[1]	35.5	2.1	<MDC	
Idaho Falls – HVP 3804	59.4	3.2	<MDC	
Idaho Falls – HVP 4304	56.0	3.0	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2016

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.09	0.11	0.17
Experimental Field Station	0.25	0.23	0.37
Sand Dunes Tower	0.18	0.18	0.29
Van Buren Avenue	0.28	0.23	0.38
Boundary Locations			
Atomic City	0.22	0.26	0.42
Howe	0.38	0.23	0.37
Mud Lake	0.27	0.17	0.27
Monteview	0.16	0.21	0.34
Distant Locations			
Craters of the Moon	0.25	0.22	0.36
Fort Hall[1]	0.21	0.27	0.44
Idaho Falls	0.41	0.24	0.39

[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, first quarter, 2016

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	100	110	170	1.3	1.8	2.9
Boundary Locations						
Atomic City	-20	100	170	1.1	1.8	3.0
Howe	50	100	170	1.1	1.8	3.0
Monteview	10	100	170	0.0	1.7	2.7
Mud Lake	0	100	170	0.1	1.4	2.7
Distant Locations						
Idaho Falls	70	110	170	0.8	1.6	2.6

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 2015.

Station Location	^{90}Sr			^{238}Pu			$^{239/240}Pu$			^{241}Am		
	Value[1]	±2SD	MDC	Value[1]	± 2SD	MDC	Value[1]	±2SD	MDC	Value[1]	±2SD	MDC
On-Site Locations												
Rest Area	5.0	4.5	7.3	2.9	3.4	5.5	3.2	2.0	0.9	0.9	2.1	3.8
EFS[3]	3.3	4.1	6.9	2.9	4.4	7.6	2.3	2.2	2.9	1.3	2.6	4.7
Sand Dunes	-2.1	4.0	7.1	5.7	4.0	5.5	1.4	1.6	1.0	1.1	2.0	3.5
Van Buren	2.6	4.2	7.1	2.3	4.5	7.9	0.8	1.9	3.6	-1.4	2.5	5.4
Boundary Locations												
Atomic City	5.8	5.5	9.0	2.9	3.4	5.6	1.4	1.6	1.0	1.2	1.7	2.9
Howe	2.5	4.0	6.8	7.5	4.9	6.6	2.5	2.0	1.1	0.8	3.7	6.7
Monteview	-2.3	4.4	7.8	3.0	4.6	7.8	-0.6	1.5	3.5	-0.8	2.8	5.6
Mud Lake	1.9	4.0	6.9	0.9	3.6	6.7	1.0	2.0	3.7	0.5	2.6	4.9
Distant Locations												
Craters of Moon	-1.3	4.5	7.8	3.6	4.8	8.0	2.8	2.5	3.5	1.3	3.3	6.0
Fort Hall[2]	1.7	3.5	6.0	5.4	4.4	6.5	-0.3	2.2	4.7	2.2	2.7	4.4
Idaho Falls 3804	-2.8	4.9	8.6	6.1	4.7	7.0	0.7	1.9	3.6	2.0	3.0	5.1
Idaho Falls 4304	0.1	3.8	6.6	1.3	3.1	5.6	1.9	1.8	2.4	4.1	2.9	4.1

Note: Concentrations are reported in 1 x 10^{-6} pCi/m^3 with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar year.
[1] Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons. DEQ-INL OP's action levels of 190 for americium-241, 1900 for strontium-90, 210 for plutonium-238, and 200 for plutonium-239/240 (in 1 x 10^{-6} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.
[2] Operated by Shoshone-Bannock Tribes.
[3] Experimental Field Station.

Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the first quarter of 2016 (**Figure 1**). To detect gamma radiation, each station is instrumented with triplicate electret ionization chambers (EIC), and 11 of the stations also are equipped with a high-pressure ion chamber (HPIC) (**Table 7**).

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

HPICs are instruments capable of real-time measurements, and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the HPICs at each location are radioed to DEQ-INL OP and presented graphically via the worldwide web at http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx.

EICs are a passive-integrating system that provides a cumulative measure of environmental gamma radiation exposure in the field. EICs are deployed, collected, and analyzed quarterly. EICs offer an inexpensive methodology to measure gamma radiation over a wide area, particularly in regions which do not have a power source. EICs can also provide valuable gamma radiation data in the event of an emergency. For this reason EICs are deployed at an additional 40 locations by DEQ-INL OP in a widespread network around the INL measuring external radiation. This information is tabulated in **Appendix B.**

These two systems are used by DEQ-INL OP to measure external gamma radiation for various radiological monitoring objectives. **Table 8** lists the average radiation exposure rates measured by the HPICs for first quarter 2016. **Table 9** lists the EIC monitoring results for first quarter 2016. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 7. Summary of instrumentation at radiation monitoring stations.

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

Table 8. Average gamma exposure rates, first quarter, 2016, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
[1]Base of Howe	n/a	n/a
Big Lost River Rest Area	13.4	2.8
Main Gate	13.4	2.8
[2]Rover	14.5	2.0
Sand Dunes Tower	12.1	1.8
Boundary Locations		
Atomic City	11.2	2.2
[1]Big Southern Butte	n/a	n/a
[1]Howe Met Tower	n/a	n/a
Monteview	11.8	2.2
Mud Lake / Terreton	13.0	1.8
Distant Locations		
Fort Hall	11.9	1.8
Idaho Falls	12.4	1.9

[1]Base of Howe, Big Southern Butte, and Howe Met Tower HPIC electronics had various electronic malfunctions or extreme temperature interference and the data was therefore unusable for determining exposure rates for first quarter 2016.
[2]Rover location was operational between 1/1/2016 and 1/31/2016, and the average shown in the table above for Rover is for this date range. Electronics have since been repaired or replaced and these locations are operating as of second quarter 2016.

Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2016.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	12.0	3.0
Big Lost River Rest Area	12.0	0.9
Experimental Field Station	14.9	0.5
Main Gate	12.8	3.1
Rover	12.9	0.2
Sand Dunes Tower	16.2	2.6
Van Buren Avenue	15.4, 16.5	
Boundary Locations		
Atomic City	14.4, 14.7	
Big Southern Butte	10.9	0.4
Howe Met Tower	16.3	0.3
Monteview	13.0, 15.7	
Mud Lake/Terreton	11.0, 12.3	
Distant Locations		
Craters of the Moon	12.0	3.2
Fort Hall	10.0, 10.2	
Idaho Falls	11.9	2.0

[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

Water monitoring sites are sampled for the purposes of examining trends of INL contaminants and other general ground water quality indicators and for verifying DOE monitoring results. Sites sampled include ground water locations (wells and springs), surface water locations (streams), and selected wastewater sites. Sample sites have been selected to aid in identifying INL impacts on the Eastern Snake River Plain Aquifer (ESRPA), and are categorized as up-gradient, facility, boundary, distant, surface water, and waste water, (**Figure 2 and Figure 3**). Up-gradient locations are not impacted by INL operations and are considered representative of background ground water quality conditions. Facility sites are sample locations on the INL near facilities, in areas of known contamination, or wells selected to illustrate trends for specific INL contaminants or indicators of ground water quality. Boundary locations are on or near the perimeter of the INL and are down-gradient of potential sources of INL contamination. Distant locations are monitored to provide trends in water quality down-gradient of the INL and include wells and springs used for irrigation, public water supply, livestock, domestic, and industrial purposes. During the first quarter of 2016, 1 facility location was sampled.

Most sites sampled by DEQ-INL OP are sampled with another agency or organization. Samples are collected at about the same time using the same collection equipment as the other agency or organization (co-sampled). DEQ-INL OP verifies work by these agencies monitoring on behalf of DOE by comparing results from co-sampled sites.

Gross alpha and gross beta analyses are conducted as a screening tool for alpha and beta emitting radionuclides potentially released from INL operations. Quantitative gamma analyses are conducted to

identify and determine concentrations of gamma emitting radionuclides. Selected sites are sampled for the man-made, alpha emitting isotopes of plutonium (^{238}Pu, $^{239/240}$Pu), uranium (^{234}U, ^{235}U, and ^{238}U), and americium (^{241}Am); and beta emitting radionuclides technetium-99 (^{99}Tc), strontium-90 (^{90}Sr), and tritium (^{3}H), based on historic INL contamination. In the event of suspect or unexpected levels of gross radioactivity, additional samples may also be analyzed for other specific radionuclides.

Gross alpha radioactivity was detected at the lone facility location sampled during the first quarter of 2016. The gross alpha concentration was within the range of concentrations observed for naturally-occurring radioactivity. The EPA maximum contaminant level (MCL) for alpha particles is 15 pCi/L.

Gross beta radioactivity was detected at the facility location sampled this quarter. The concentration observed is consistent with historic concentrations found at this location. The MCL for beta and gamma radioactivity is 4 mrem/year, equivalent to 8 pCi/L if the source is ^{90}Sr; 900 pCi/L if ^{99}Tc; 20,000 pCi/L if tritium (^{3}H); or 200 pCi/L if ^{137}Cs. Man-made, gamma emitting radioactivity was not detected at the sampled facility location. Results for gross alpha; gross beta; and man-made, gamma emitting ^{137}Cs are shown in **Table 10**.

The facility site was sampled for isotopes of plutonium, with the result for ^{238}Pu reporting as non-detectable (**Table 11**). The result for $^{239/240}$Pu was greater than the MDC; however, the value is less than three standard deviations and is considered a non-detection. Uranium isotopes were also sampled for at the facility site (**Table 12**), with ^{234}U and ^{238}U reporting in detectable concentrations. The result for ^{235}U was greater than the MDC; however, the value is less than three standard deviations and is considered a non-detection. The results observed at the sample site cannot be distinguished from background values, which means the uranium found in the samples is likely to be naturally occurring. The facility site was also sampled for ^{241}Am and ^{90}Sr this quarter. Neither nuclide was detected (**Table 13 and Table 14**). Technetium-99 was sampled for and detected; however, the reported concentration is within the expected range for this site (**Table 15**).

Using the standard analytical method, ^{3}H was detected at the facility location (**Table 16**). The tritium level found at this facility well is similar to historic concentrations for this site and is consistent with INL waste disposal influences at the INTEC facility. Selected water samples with tritium concentrations not measurable using the standard method (typically a MDC of 130 pCi/L) are analyzed using an electrolytic enrichment method with a much lower MDC of 10 to 14 pCi/L. There were no samples analyzed using the enrichment method for the current quarter; however, sample analyses from four sites collected during previous quarters were completed and presented this quarter (**Table 17**). A backlog of 52 samples remains.

Samples were also analyzed for metals and the results shown in **Table 18**. All results are within their expected ranges. Common ion results are shown in **Table 19** and nutrient results are shown in **Table 20**. All results are consistent with the expected values at each location. Samples were not analyzed for volatile organic compounds (VOC's) this quarter.

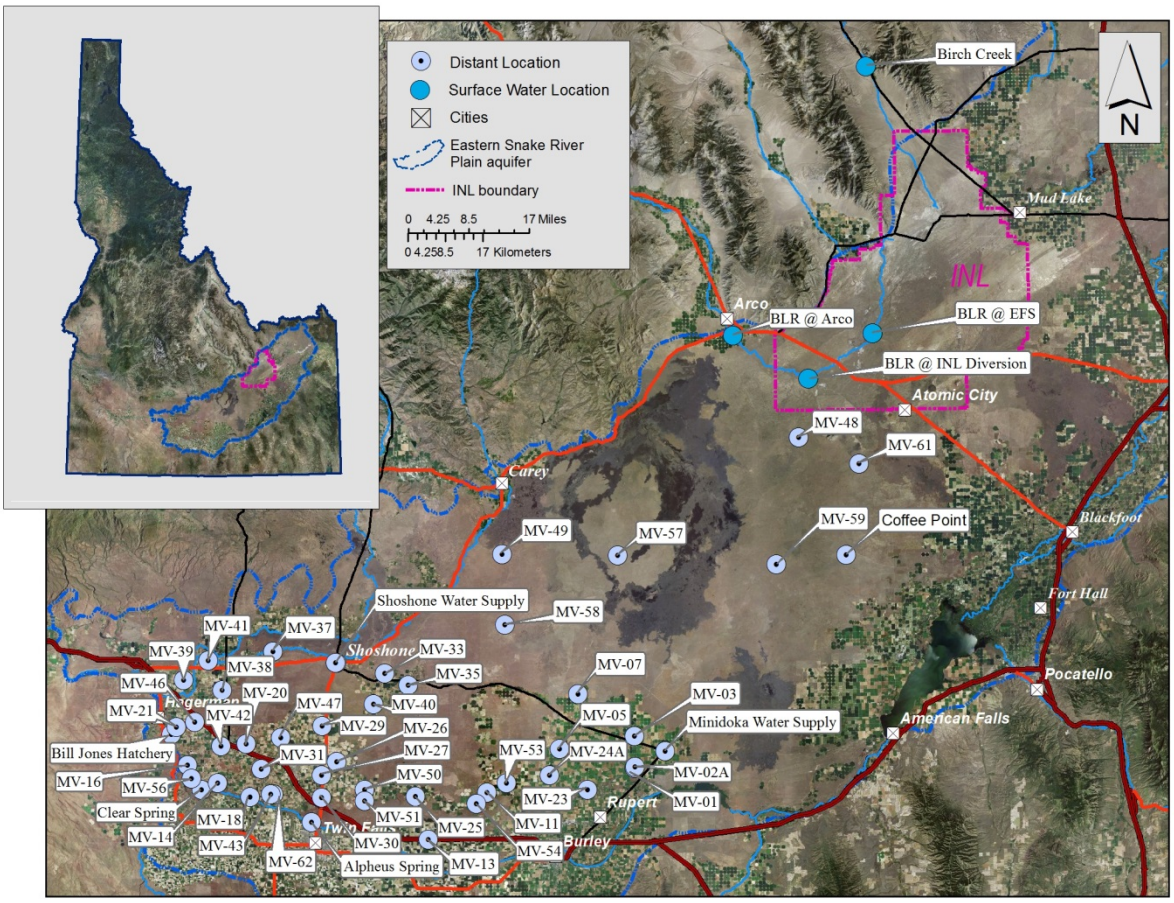

Figure 2. Distant and Surface Water monitoring locations.

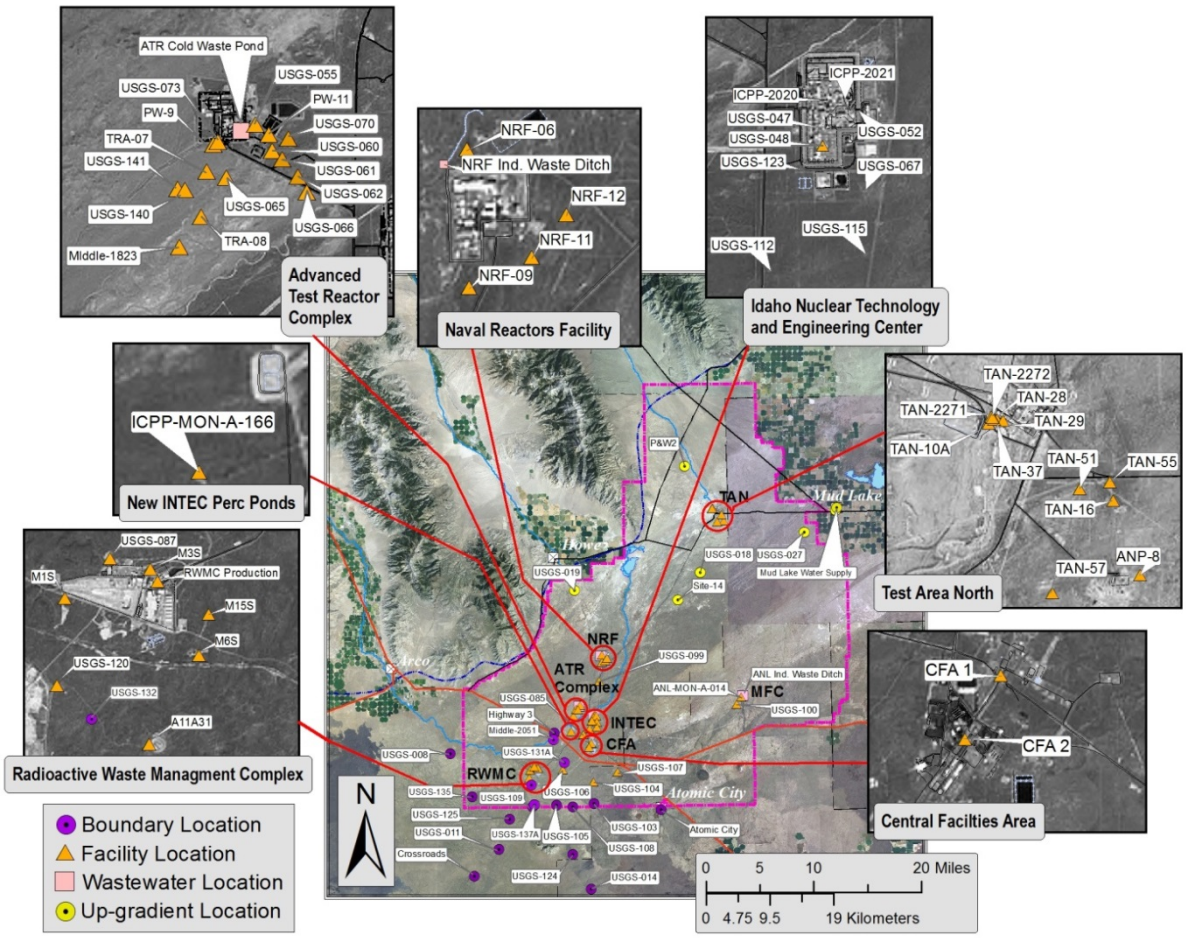

Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

Table 10. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations for water samples, first quarter, 2016.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Man-made gamma-emitting radionuclide Cesium-137		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Facility										
USGS-123	3/1/2016	1.9		0.8	3.4		0.8	-0.1	U	1.3

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

Table 11. Reported concentrations of plutonium isotopes in water samples, first quarter, 2016.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240			Plutonium-241		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Facility										
USGS-123	3/1/2016	0.005	U	0.013	0.010	U*	0.013	NR	-	-

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, NR = analysis not requested.

[2]Concentrations expressed in pCi/L.

*The result is greater than the MDC but is less than 3 SD so is therefore considered a non-detection.

Table 12. Reported concentrations of uranium isotopes in water samples, first quarter, 2016.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Facility										
USGS-123	3/1/2016	1.29		0.26	0.040	U*	0.031	0.64		0.15

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

*The result is greater than the MDC but is less than 3 SD so is therefore considered a non-detection.

Table 13. Reported concentrations of americium-241 in water samples, first quarter, 2016.

Sample Location	Sample Date	Americium-241		
		Concentration[1,2]		±2 SD
Facility				
USGS-123	3/1/2016	-0.013	U	0.014

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

Table 14. Reported concentrations of strontium-90 in water samples, first quarter, 2016.

Sample Location	Sample Date	Strontium-90		
		Concentration[1,2]		±2 SD
Facility				
USGS-123	3/1/2016	0.10	U	0.30

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

Table 15. Reported concentrations of technetium-99 in water samples, first quarter, 2016.

Sample Location	Sample Date	Technetium-99		
		Concentration[1,2]		±2 SD
Facility				
USGS-123	3/1/2016	0.9		0.1

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L. Samples are filtered unless otherwise indicated.

Table 16. Tritium concentrations for water samples, first quarter, 2016.

Sample Location	Sample Date	Tritium		
		Concentration[1,2]		±2 SD
Facility				
USGS-123	3/1/2016	2120		130

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

Table 17. Enriched tritium concentrations for water samples from previous sampling quarters.

Sample Location	Sample Date	Enriched Tritium		
		Concentration[1,2]		±2 SD
Boundary				
Crossroads	4/22/2015	25		6
Distant				
MV-33	6/30/2015	21		6
MV-46	6/30/2015	20		7
MV-59	6/11/2015	3		5

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.

[2]Concentrations expressed in pCi/L.

Table 18. Reported metals concentrations in water samples, first quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]															
		Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Facility																	
USGS-123	3/1/2016	<2.0	U	46		6.2		<10	U	<1.0	U	2.2		<2.0	U	<10	U

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, "<" = a result below the Minimum Detectable Concentration (MDC), NR = analysis not requested.

[2]Concentrations are expressed in µg/L. Samples are filtered unless otherwise indicated.

Table 19. Reported common ion concentrations in water samples, first quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]															
		Calcium		Magnesium		Sodium		Potassium		Fluoride		Chloride		Sulfate		Alkalinity[3]	
Facility																	
USGS-123*	3/1/2016	38		15		10		2.9		<0.20	U	21.4		21.9		130	

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected. * = samples are filtered for calcium, magnesium, sodium and potassium. "<" = a result below the Minimum Detectable Concentration (MDC). NR = analysis not requested.

[2]Concentrations are expressed in mg/L.

[3]As $CaCO_3$.

Table 20. Reported nutrient concentrations in water samples, first quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]			
		Nitrite + Nitrate		Phosphorus	
Facility					
USGS-123	3/1/2016	1.1		0.024	

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, NR = analysis not requested.

[2]Concentrations expressed in mg/L. Samples are filtered unless otherwise noted.

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 2016.

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 21**. ^{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 21. Gamma spectroscopy analysis data for milk samples, first quarter, 2016.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Riverside	03/06/2016	1489	113	<MDC
Gooding/Glanbia	01/07/2016	1406	97	<MDC
	02/23/2016	1503	113	<MDC
	03/31/2016	1469	113	<MDC
Verification Samples[2]				
Dietrich	01/05/2016	1359	112	<MDC
Howe	01/13/2016	1451	116	<MDC
Terreton	02/02/2016	1455	100	<MDC
Rupert	02/02/2016	1607	103	<MDC
Idaho Falls	03/08/2016	1351	111	<MDC
Dietrich	03/08/2016	1359	96	<MDC

[1] <MDC – Less than Minimum Detectable Concentration (approximately 4 pCi/L for iodine-131).
[2] DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.
[3] Concentrations with associated uncertainties (±2 SD) are expressed in pCi/L.

Quality Assurance

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

This section summarizes the results of the quality assurance (QA) assessment of the data collected for the first quarter of 2016 for the DEQ-INL OP's ESP. It also summarizes the quality control (QC) samples (spikes, blanks, and duplicates) submitted to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses and to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses during the quarter. All analyses and QC measures at the analytical laboratories used by the ESP are performed in accordance with approved written procedures maintained by each respective analytical laboratory. Sample collection is performed in accordance with written procedures maintained by the DEQ-INL OP.

Analytical results for blanks, duplicates, and spikes are used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During the first quarter of 2016, the DEQ-INL OP submitted 50 QC samples for various radiological and non-radiological analyses (**Table 22**).

Blank Samples

Blank samples consist of matrices that have negligible, acceptably low, or immeasurable amounts of the analyte(s) of interest in them. They are designed to determine if an analysis will yield a "zero" result when no contaminant is present, or a sufficiently low result to serve as an acceptable measure of "background." Blank samples are used to monitor for bias introduced during sample collection, storage, shipment, and analysis. Blank sample results submitted for gross alpha and gross beta screening in air for the first quarter of 2016 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 analysis results for radiochemical separation analyses for TSP particulate filters collected during 2015 are presented in **Table 26.** Blank analyses results for radiological and non-radiological analytes in ground and surface water are presented in **Table 27**, **Table 28**, and **Table 29**.

There was one anomaly observed from the assessment of field blank water samples as measured by the analytical laboratories used by DEQ-INL OP for the first quarter of 2016. The anomaly includes a result for Total Alkalinity found at 1 mg/L, which is above the MDC. There was one sample result reported for Total Alkalinity this quarter of 130 mg/L (**Table 19**), which is significantly above the blank value of 1 mg/L; no qualifiers or flags will be attached with any Total Alkalinity results this quarter.

Duplicate Samples

A laboratory's analytical precision capability, i.e, its ability to reproduce results, is assessed by comparing duplicate sample results. Duplicate samples are samples collected from the same location at approximately the same time and are considered to be essentially identical in composition. The difference between duplicate sample results is expressed as the relative percent difference (RPD), calculated from the following equation:

$RPD = (R_1 – R_2)/((R_1 + R_2)/2)*100$

Where:

R_1 = First sample result.

R_2 = Second sample result.

A relative percent difference of up to ± 20 percent is acceptable. For non-radiological analysis, the RPD is used to compare each set of duplicate samples in which both of the results exceed five times the detection level. If one or both of the duplicate sample results are less than five times the detection level, the absolute difference between the two results is acceptable if it is less than or equal to the method detection limit.

For radiological analysis, the RPD is calculated (using the above equation) to compare duplicate samples if both duplicate results are greater than the sample-specific minimum detectable concentration (MDC). DEQ-INL OP also considers duplicate sample results that have an absolute difference of no more than three times the pooled error (or "3 sigma") to be in acceptable agreement. This is accomplished using the following equation:

$|R_1 – R_2| \leq 3(S_1^2 + S_2^2)^{1/2}$

Where:

R_1 = First sample result.

R_2 = Second sample result.

S_1 = Uncertainty (one standard deviation) associated with the laboratory measurement of the first sample.

S_2 = Uncertainty (one standard deviation) associated with the laboratory measurement of the second sample.

Radiological duplicate sample results satisfying either the RPD or pooled error test are considered acceptable.

One duplicate water sample comparison was completed for ground water; results are presented in **Table 30** for radiological analyses. The duplicate comparison passed DEQ-INL criteria for the first quarter of 2016.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added (spiked) in order to assess the bias a laboratory may have in accurately measuring these analytes. To determine agreement after laboratory analysis, DEQ-INL OP calculates the ratio of the spike concentration determined from the laboratory measurement to the known spike concentration in the sample. This result is known as percent recovery (%R) and the acceptable range used by DEQ-INL OP is 100 ± 25 percent. Additionally, all results were qualified as "estimates (J)" if the associated quality control spike sample had a recovery of 50 – 74% or 126 – 150%, provided that each result was greater than the instrument detection limit (IDL). All results were qualified as "rejected (R)" if the associated quality control spike sample had a recovery of < 50% or > 150%, provided each result was also greater than the IDL.

Spike samples were not used during the first quarter of 2016.

DEQ-INL OP also prepares additional “spike-like” quality control samples to assess ambient radiation measurement bias. Once per quarter, DEQ-INL OP irradiates a number of electret ionization chambers (EICs) to verify EIC response. Irradiations of EICs are conducted in a repeatable geometry to a known exposure of near 30 mR and two additional higher and lower exposures, ranging from 15 to 60 mR. EIC responses are compared directly with the exposure received from the NIST traceable cesium-137 source provided by ISU-EML. EIC response is considered acceptable if each measurement has a percent recovery of 100 ± 25% when compared to the known irradiated quantity. The irradiation results for first quarter 2016 are presented in **Table 31**. 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.

Analytical QA/QC Assessment

Other than those listed above, 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 2016, which significantly affected data quality. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the first quarter of 2016.

Data usability is the measure of data that is not rejected compared to the amount that was expected to be obtained. The overall data usability rate for the first quarter of 2016 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 22**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the first quarter of 2016, the radioiodine pump was replaced at the Monteview and Experimental Field Station sampling stations. Service reliability for air sampling equipment for the first quarter of 2016 is summarized in **Table 32**.

Conclusion

All data collected for the first quarter of 2016 have been assigned the applicable qualifiers to designate the appropriate use of the data. In addition, all data have been verified and deemed complete meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 22. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, first quarter, 2016.

Media Sampled	Collection Device	Analyte	Test Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected[1]	Analyzing Lab[2]
Air								
Particulate	4-inch filter	Gross alpha	156	13	0	0	2	ISU-EML
		Gross beta	156	13	0	0	2	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	48	4	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	22	2	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	6	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	1	1	0	0	0	ISU-EML
		Gross beta	1	1	0	0	0	ISU-EML
		Gamma emitters	1	1	0	0	0	ISU-EML
		Tritium	1	1	0	0	0	ISU-EML
		Enriched tritium	4	0	1	0	0	ISU-EML
		Technetium-99	1	0	0	0	0	ISU-EML
		Radiochemical	4	0	0	0	0	ISU Sub
		Metals	1	1	0	0	0	IBL
		Common Ions	1	1	0	0	0	IBL
		Nutrients	1	1	0	0	0	IBL
		Volatile Organics	0	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	10	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	54	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	9	NA	NA	NA	0	DEQ-INL OP
Total Analyses			**508**	**40**	**1**	**9**	**4**	
Total of QC Analyses (blanks, duplicates, and spikes)			**50**					
Percentage of QC analyses of total Test analyses[3]			**9.8%**					
Percentage of usable data[4]			**99.2%**					

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

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

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

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

Table 23. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2016.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
12/30/15	01/07/16	2055	0.0	0.1	-0.2	0.5
01/07/16	01/14/16	2055	0.0	0.1	0.4	0.5
01/14/16	01/22/16	2055	0.1	0.2	-0.2	0.5
01/22/16	01/28/16	2055	0.1	0.1	-0.5	0.5
01/28/16	02/04/16	2055	-0.1	0.1	0.2	0.5
02/04/16	02/11/16	2055	0.1	0.1	0.2	0.5
02/11/16	02/18/16	2055	0.0	0.1	0.4	0.5
02/18/16	02/25/16	2055	0.1	0.1	-0.3	0.5
02/25/16	03/02/16	2055	0.0	0.1	0.1	0.5
03/02/16	03/10/16	2055	-0.1	0.1	-0.3	0.5
03/10/16	03/17/16	2055	0.0	0.1	0.0	0.5
03/17/16	03/24/16	2055	0.0	0.1	-0.5	0.5
03/24/16	03/31/16	2055	0.1	0.1	0.2	0.5

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

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

Table 24. Blank analysis results for gamma spectroscopy for TSP particulate air filters, first quarter, 2016.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
05/02/16	1	26	44	2	0	77	-3	7	11

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
05/02/16	-1	2	4	1	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, first quarter, 2016.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP161ZTR01	04/12/16	04/13/16	04/20/16	0.10	0.08	0.14
OP161ZTR02	04/12/16	04/13/16	04/20/16	0.10	0.08	0.13

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

Table 26. Blank analysis results for 2015 TSP annual radiochemical composites of air filters.

Location	^{90}Sr			^{238}Pu			^{239}Pu/^{240}Pu			^{241}Am		
	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC
Blank	0.03	0.43	0.75	0.23	0.23	0.35	0.03	0.13	0.13	0.26	0.26	0.42

Note: Concentrations are expressed in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1] These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar year. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air was actually passed through the blank filters.

Table 27. Radiological blank analysis results in groundwater and/or surface water, first quarter, 2016.

Sample Number	Sample Date	Concentration[1]	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
161W001	3/1/2016	0.4	0.3	0.4	Yes
Gross Beta					
161W001	3/1/2016	-0.2	0.5	0.9	Yes
Cesium-137					
161W001	3/1/2016	0.9	1.1	1.8	Yes
Tritium					
161W002	3/1/2016	-20	60	110	Yes

[1] Concentrations are expressed in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentrations (MDC).

Table 28. Blank analysis results (µg/L) for metals in groundwater and/or surface water, first quarter, 2016.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
161W004	3/1/2016	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	<10

Table 29. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, first quarter, 2016.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
161W005,004,003	3/1/2016	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	1.0	<0.01	<0.005

Table 30. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, first quarter, 2016.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	$/R_1-R_2/$	$3(S_1^2+S_2^2)^{1/2}$	Within Criteria?[1]
Enriched Tritium									
MV-59	151W416	3	5	151W422	-6	9	9	15	Yes

[1] $|R_1-R_2| \leq 3(S_1^2+S_2^2)^{1/2}$

Table 31. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2016.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SHD911	42.1	2.1	41.1	1.3	98%	Y
SGP544	42.1	2.1	36.9	1.2	88%	Y
SHC734	42.1	2.1	42.0	1.3	100%	Y
SHD929	30.0	1.5	28.3	1.3	94%	Y
SHC660	30.0	1.5	24.8	1.4	83%	Y
SHC840	30.0	1.5	27.8	1.3	93%	Y
SHC646	21.1	1.1	20.8	1.3	99%	Y
SGO572	21.1	1.1	20.8	1.3	99%	Y
SHC748	21.1	1.1	21.8	1.3	103%	Y

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

Table 32. Air sampling field equipment service reliability (percent operational), first quarter, 2016.

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

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

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

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2016.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	12/30/15	01/07/16	1.1	0.2	66.0	1.6
	01/07/16	01/14/16	0.8	0.2	52.0	1.5
	01/14/16	01/22/16	1.0	0.2	38.6	1.2
	01/22/16	01/28/16	0.4	0.2	31.6	1.4
	01/28/16	02/04/16	0.4	0.2	27.4	1.2
	02/04/16	02/11/16	0.9	0.2	45.4	1.4
	02/11/16	02/18/16	0.9	0.2	42.6	1.4
	02/18/16	02/25/16	0.2	0.1	15.8	0.9
	02/25/16	03/02/16	0.7	0.2	25.2	1.3
	03/02/16	03/10/16	0.5	0.2	18.3	0.9
	03/10/16	03/17/16	0.4	0.2	11.8	0.8
	03/17/16	03/24/16	0.6	0.2	18.5	1.0
	03/24/16	03/31/16	0.5	0.2	14.9	0.9
Experimental Field Station	12/30/15	01/07/16	1.2	0.2	68.5	1.7
	01/07/16	01/14/16	0.8	0.2	49.7	1.5
	01/14/16	01/22/16	1.1	0.3	41.7	1.5
	01/22/16	01/28/16	0.5	0.2	33.1	1.4
	01/28/16	02/04/16	0.5	0.2	26.6	1.2
	02/04/16	02/11/16	0.8	0.2	40.1	1.4
	02/11/16	02/18/16	1.0	0.2	44.3	1.5
	02/18/16	02/25/16	0.4	0.2	14.3	0.9
	02/25/16	03/02/16	0.4	0.2	24.2	1.3
	03/02/16	03/10/16	0.3	0.2	15.2	0.9
	03/10/16	03/17/16	0.4	0.2	10.7	0.8
	03/17/16	03/24/16	0.5	0.3	13.4	1.7
	03/24/16	03/31/16	0.5	0.2	11.6	0.9
Sand Dunes Tower	12/30/15	01/07/16	1.2	0.2	65.3	1.5
	01/07/16	01/14/16	0.6	0.2	33.4	1.2
	01/14/16	01/22/16	1.0	0.2	30.5	1.1
	01/22/16	01/28/16	0.2	0.2	24.9	1.2
	01/28/16	02/04/16	0.3	0.2	24.2	1.1
	02/04/16	02/11/16	0.4	0.2	31.9	1.2
	02/11/16	02/18/16	0.8	0.2	43.0	1.4
	02/18/16	02/25/16	0.2	0.1	10.0	0.8
	02/25/16	03/02/16	0.3	0.2	21.7	1.1
	03/02/16	03/10/16	0.3	0.1	12.1	0.7
	03/10/16	03/17/16	0.3	0.1	9.1	0.7
	03/17/16	03/24/16	0.4	0.2	11.9	0.8
	03/24/16	03/31/16	0.2	0.1	8.6	0.7

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2016.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/30/15	01/07/16	1.1	0.2	53.1	1.4
	01/07/16	01/14/16	0.5	0.2	31.4	1.2
	01/14/16	01/22/16	0.8	0.2	28.1	1.1
	01/22/16	01/28/16	0.4	0.2	21.3	1.1
	01/28/16	02/04/16	0.5	0.2	18.8	1.0
	02/04/16	02/11/16	0.6	0.2	31.3	1.2
	02/11/16	02/18/16	0.7	0.2	30.1	1.2
	02/18/16	02/25/16	0.6	0.2	10.2	0.8
	02/25/16	03/02/16	0.6	0.2	20.2	1.2
	03/02/16	03/10/16	0.5	0.2	13.3	0.8
	03/10/16	03/17/16	0.3	0.2	9.0	0.8
	03/17/16	03/24/16	0.5	0.2	13.8	0.9
	03/24/16	03/31/16	0.5	0.2	10.7	0.8
Boundary Locations						
Atomic City	12/30/15	01/07/16	1.2	0.2	63.0	1.5
	01/07/16	01/14/16	0.6	0.2	39.2	1.3
	01/14/16	01/22/16	0.8	0.2	27.4	1.0
	01/22/16	01/28/16	0.5	0.2	25.6	1.2
	01/28/16	02/04/16	0.5	0.2	20.4	1.0
	02/04/16	02/11/16	0.3	0.2	39.4	1.3
	02/11/16	02/18/16	0.7	0.2	31.7	1.2
	02/18/16	02/25/16	0.2	0.1	11.8	0.8
	02/25/16	03/02/16	0.5	0.2	23.0	1.2
	03/02/16	03/10/16	0.4	0.2	15.4	0.8
	03/10/16	03/17/16	0.7	0.2	11.7	0.9
	03/17/16	03/24/16	0.5	0.2	15.3	0.9
	03/24/16	03/31/16	0.3	0.2	11.3	0.8
Howe	12/30/15	01/07/16	1.1	0.2	53.8	1.5
	01/07/16	01/14/16	0.5	0.2	35.8	1.3
	01/14/16	01/22/16	0.8	0.2	29.7	1.1
	01/22/16	01/28/16	0.3	0.2	23.0	1.4
	01/28/16	02/04/16	0.0	0.2	15.4	0.9
	02/04/16	02/11/16	0.5	0.2	31.7	1.3
	02/11/16	02/18/16	0.7	0.2	40.8	1.4
	02/18/16	02/25/16	0.5	0.2	10.8	0.8
	02/25/16	03/02/16	0.6	0.2	22.9	1.2
	03/02/16	03/10/16	0.4	0.2	13.8	0.8
	03/10/16	03/17/16	0.3	0.2	9.1	0.8
	03/17/16	03/24/16	0.5	0.2	13.5	0.9
	03/24/16	03/31/16	0.4	0.2	9.8	0.8

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2016.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	12/30/15	01/07/16	1.2	0.2	63.7	1.6
	01/07/16	01/14/16	0.6	0.2	40.0	1.4
	01/14/16	01/22/16	0.8	0.2	29.0	1.1
	01/22/16	01/28/16	0.7	0.2	34.4	1.4
	01/28/16	02/04/16	0.3	0.2	24.0	1.1
	02/04/16	02/11/16	0.7	0.2	41.8	1.4
	02/11/16	02/18/16	1.3	0.3	65.3	1.8
	02/18/16	02/25/16	0.4	0.2	9.7	0.8
	02/25/16	03/02/16	0.7	0.2	26.1	1.3
	03/02/16	03/10/16	0.5	0.2	13.9	0.9
	03/10/16	03/17/16	0.4	0.2	11.2	0.8
	03/17/16	03/24/16	0.5	0.2	15.3	1.0
	03/24/16	03/31/16	0.4	0.2	11.0	0.8
Mud Lake	12/30/15	01/07/16	1.9	0.3	86.7	1.8
	01/07/16	01/14/16	0.9	0.2	58.3	1.6
	01/14/16	01/22/16	1.4	0.3	43.9	1.3
	01/22/16	01/28/16	0.7	0.2	39.2	1.5
	01/28/16	02/04/16	0.5	0.2	30.8	1.2
	02/04/16	02/11/16	0.9	0.2	46.7	1.5
	02/11/16	02/18/16	1.4	0.3	74.7	1.9
	02/18/16	02/25/16	0.5	0.2	18.7	1.0
	02/25/16	03/02/16	0.7	0.2	33.1	1.4
	03/02/16	03/10/16	0.6	0.2	19.5	0.9
	03/10/16	03/17/16	0.9	0.2	17.3	1.0
	03/17/16	03/24/16	1.1	0.2	17.9	1.0
	03/24/16	03/31/16	0.8	0.2	15.9	0.9
Distant Locations						
Craters of the Moon	12/30/15	01/07/16	0.5	0.2	31.0	1.2
	01/07/16	01/14/16	0.2	0.2	27.0	1.2
	01/14/16	01/22/16	0.3	0.2	11.8	0.8
	01/22/16	01/28/16	0.3	0.2	15.1	1.1
	01/28/16	02/04/16	0.3	0.2	12.5	0.9
	02/04/16	02/11/16	0.3	0.2	20.8	1.0
	02/11/16	02/18/16	R[1]	R[1]	R[1]	R[1]
	02/18/16	02/25/16	0.3	0.1	10.2	0.8
	02/25/16	03/02/16	R[1]	R[1]	R[1]	R[1]
	03/02/16	03/10/16	0.3	0.1	9.5	0.7
	03/10/16	03/17/16	0.1	0.1	6.5	0.7
	03/17/16	03/24/16	0.5	0.2	13.8	0.9
	03/24/16	03/31/16	0.3	0.1	9.4	0.8

[1]R – Results rejected due to insufficient sample volume caused by a tripped breaker.

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2016.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	12/30/15	01/07/16	0.7	0.2	34.5	1.2
	01/07/16	01/14/16	0.7	0.2	25.1	1.1
	01/14/16	01/22/16	0.5	0.2	10.7	0.7
	01/22/16	01/28/16	0.7	0.2	17.4	1.1
	01/28/16	02/04/16	0.3	0.2	12.7	0.9
	02/04/16	02/11/16	0.9	0.2	27.1	1.2
	02/11/16	02/18/16	0.8	0.2	22.7	1.1
	02/18/16	02/25/16	0.5	0.2	10.3	0.8
	02/25/16	03/02/16	0.6	0.2	14.9	1.0
	03/02/16	03/10/16	0.3	0.1	10.7	0.7
	03/10/16	03/17/16	0.3	0.2	8.2	0.7
	03/17/16	03/24/16	0.6	0.2	12.2	0.9
	03/24/16	03/31/16	0.3	0.2	9.6	0.8
Idaho Falls - HVP 3804	12/30/15	01/07/16	1.4	0.3	61.8	1.6
	01/07/16	01/14/16	0.8	0.2	48.5	1.5
	01/14/16	01/22/16	0.8	0.2	28.0	1.1
	01/22/16	01/28/16	0.4	0.2	28.3	1.3
	01/28/16	02/04/16	0.5	0.2	23.6	1.2
	02/04/16	02/11/16	0.8	0.2	42.3	1.4
	02/11/16	02/18/16	0.9	0.2	43.1	1.4
	02/18/16	02/25/16	0.5	0.2	15.0	0.9
	02/25/16	03/02/16	0.8	0.2	25.6	1.3
	03/02/16	03/10/16	0.5	0.2	18.1	0.9
	03/10/16	03/17/16	0.7	0.2	14.0	0.9
	03/17/16	03/24/16	0.5	0.2	18.6	1.0
	03/24/16	03/31/16	0.6	0.2	14.8	0.9
Idaho Falls - HVP 4304[2]	12/30/15	01/07/16	1.4	0.3	59.1	1.5
	01/07/16	01/14/16	0.8	0.2	49.2	1.5
	01/14/16	01/22/16	0.8	0.2	30.8	1.1
	01/22/16	01/28/16	0.5	0.2	37.9	1.4
	01/28/16	02/04/16	0.6	0.2	22.0	1.2
	02/04/16	02/11/16	0.9	0.2	44.7	1.4
	02/11/16	02/18/16	0.9	0.2	37.7	1.3
	02/18/16	02/25/16	0.5	0.2	17.1	1.0
	02/25/16	03/02/16	1.0	0.3	26.8	1.3
	03/02/16	03/10/16	0.7	0.2	21.7	1.0
	03/10/16	03/17/16	0.4	0.2	13.6	0.9
	03/17/16	03/24/16	0.7	0.2	18.0	1.0
	03/24/16	03/31/16	0.5	0.2	14.4	0.9

[1] Operated by Shoshone Bannock-Tribes.

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

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2016.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/h)
Arco	12.2	3.7
Craters of the Moon	12.0	3.2
Big Lost River Rest Area	12.0	0.9
Van Buren Avenue	15.4, 16.5	
Experimental Field Station	14.9	0.5
Main Gate	12.8	3.1
Atomic City	14.4, 14.7	
Taber	9.9	2.7
Blackfoot	11.3, 11.6	
Ft. Hall	10.0, 10.2	
Idaho Falls	11.9	2.0
Mud Lake/ Terreton	11.0, 12.3	
Monteview	13.0, 15.7	
Sand Dunes Tower	16.2	2.6
Howe Met. Tower	16.3	0.3
MP276 -20	14.0, 15.7	
MP274 -20	11.1	1.2
MP272 -20	11.1	0.6
MP270 -20	12.6	2.2
MP268 -20	12.7	3.6
MP266 -20	12.3, 14.6	
MP264 -20	14.1	3.3
MP270 -20/26	12.0, 17.8	
MP268 -20/26	13.7	3.6
MP266 -20/26	14.6, 16.8	
MP263 -20/26	14.5	2.0
MP261 -20/26	11.9, 12.0	
MP259 -20/26	14.3	0.5
MFC (EBR II)	12.9	2.3
EBR I	10.1, 14.1	
RWMC	9.2, 11.3	
CFA	16.3	1.2
CITRC (PBF)	12.4	1.5
INTEC	16.4	3.3
ATR (TRA)	15.5	3.3
NRF	12.1	0.3
TAN/SMC	13.4	3.8
Mud Lake Bank of Commerce	13.4, 15.5	
MP43-33	12.6, 14.7	
MP41-33	17.0, 17.2	
MP39-33	15.9	2.2
MP 37-33	11.4, 11.9	
MP35-33	lost	
MP33-33	14.6	0.5
MP31-33	15.8	1.6
MP29-33	14.2	3.4
MP27-33	18.1, 20.9	
MP25-33	12.7	2.6
MP23-33	12.9, 12.9	
Base of Howe	12.0	3.0

Table B.1. continued. Results for all electret ionization chamber (EIC) locations, first quarter, 2016.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/h)
Rover	12.9	0.2
Hamer	15.7	3.1
Sugar City	16.1	1.4
Roberts	12.4	1.1
Big Southern Butte	10.9	0.4

[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.