Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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

Introduction

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

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

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

Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the second quarter, 2017 (**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 midway through the 3rd quarter of 2016 another model HVP 4304 TSP sampler was started at Idaho Falls air station alongside the current sampler (HVP 3804). The new sampler (HVP 4304) is being operated to test dependability and durability under field conditions. The Ft. Hall sampler was repaired during the 2nd quarter and will be restarted at the beginning of the 3rd quarter. 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 second quarter of 2017 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

Radioactive iodine samples are collected weekly. Samples are collected by drawing air through a canister filled with activated charcoal using a low-volume air pump. The activated charcoal contained in the canister traps the radioiodine by adsorption onto its porous surface. Each week, canisters are collected from all eleven air monitoring stations and analyzed together as a composite. If Iodine-131 is detected in this grouping, the canisters are individually analyzed. No radioactive isotopes of iodine, specifically Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the second 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. Weighted mean atmospheric tritium was below the minimum detectable concentration (MDC) during the second quarter of 2017. There is one individual sample within the weighted mean that exceeded MDC located at the Mud Lake sampling site: 0.76 pCi/m^3 (MDC 0.66 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 second quarter of 2017. 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 second quarter of 2017. Tritium and Cesium-137 analysis results are presented in **Table 5**.

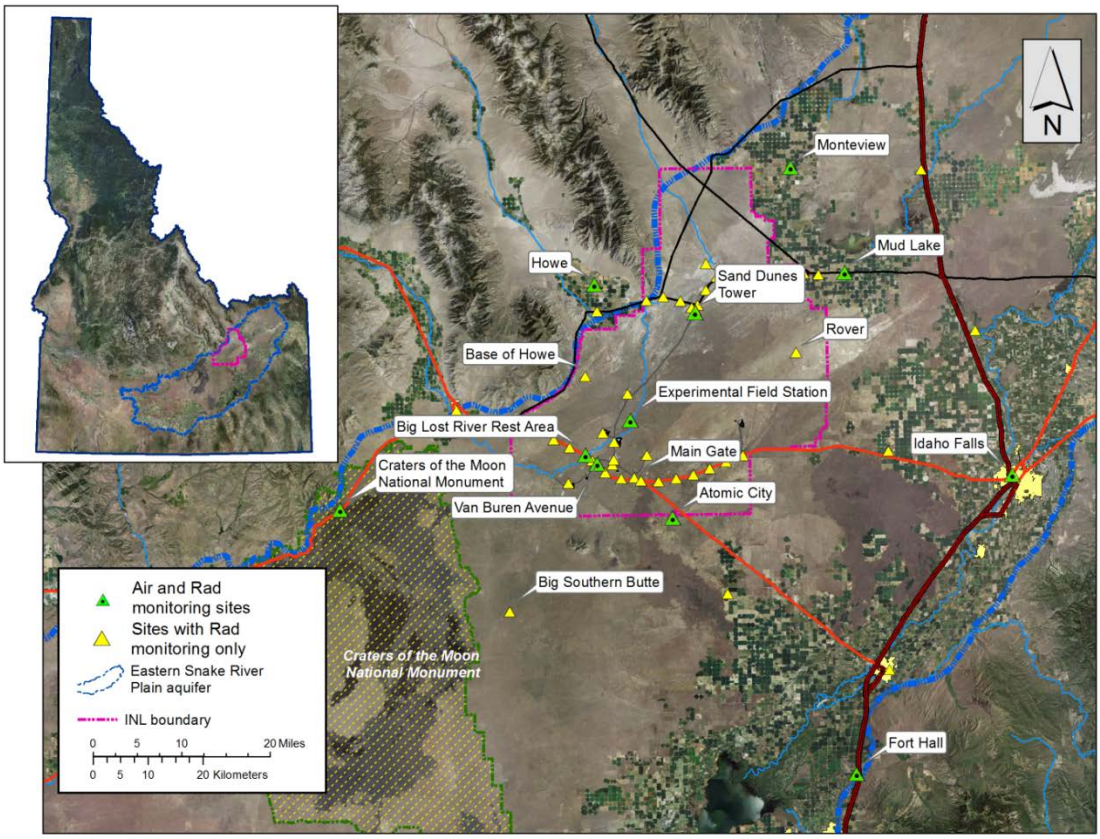

Figure 1. Air and radiation (Rad) monitoring sites.

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, second quarter, 2017.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.2	-	1.4	13.6	-	41.8
Experimental Field Station	0.2	-	1.2	10.5	-	30.9
Sand Dunes Tower	0.1	-	0.8	8.3	-	24.3
Van Buren Avenue	0.2	-	0.9	9.7	-	28.0
Boundary Locations						
Atomic City	0.2	-	1.0	9.7	-	29.7
Howe	0.3	-	0.9	9.2	-	24.8
Monteview	0.3	-	1.0	11.3	-	29.7
Mud Lake	0.4	-	1.7	14.3	-	40.7
Distant Locations						
Craters of the Moon	0.3	-	1.1	12.0	-	38.9
Fort Hall[1]	NS[2]	-	NS[2]	NS[2]	-	NS[2]
Idaho Falls – HVP 3804	0.5	-	1.5	13.7	-	39.0
Idaho Falls – HVP 4304	0.2	-	1.4	9.4	-	32.3

[1]Operated by Shoshone-Bannock Tribes.
[2]NS – sampler out of service.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, second quarter, 2017.

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	125.3	6.2	<MDC[2]	
Experimental Field Station	86.1	4.4	<MDC	
Sand Dunes Tower	65.9	3.4	<MDC	
Van Buren Avenue	76.9	4.1	<MDC	
Boundary Locations				
Atomic City	75.2	3.9	<MDC	
Howe	78.0	4.0	<MDC	
Monteview	113.0	5.7	<MDC	
Mud Lake	111.2	5.8	<MDC	
Distant Locations				
Craters of the Moon	129.0	6.7	<MDC	
Fort Hall[1]	NS[3]	NS[3]	NS[3]	
Idaho Falls – HVP 3804	102.1	5.4	<MDC	
Idaho Falls – HVP 4304	77.9	4.0	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
[3]NS – sampler out of service.
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, second quarter, 2017

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.33	0.52	0.88
Experimental Field Station	0.24	0.46	0.75
Sand Dunes Tower	0.02	0.48	0.81
Van Buren Avenue	0.30	0.43	0.71
Boundary Locations			
Atomic City	0.16	0.42	0.71
Howe	0.20	0.51	0.85
Mud Lake	0.15	0.42	0.70
Monteview	0.13	0.56	0.92
Distant Locations			
Craters of the Moon	-0.01	0.42	0.71
Fort Hall[1]	0.00	0.53	0.94
Idaho Falls	0.18	0.53	0.87

[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, second quarter, 2017

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	-20	90	150	-0.1	1.2	2.1
Boundary Locations						
Atomic City	10	90	150	-0.5	1.1	2.0
Howe	-20	90	150	0.1	1.5	2.6
Monteview	30	90	150	-0.8	1.3	2.4
Mud Lake	10	90	150	0.7	2.3	3.8
Distant Locations						
Idaho Falls	-10	90	150	0.2	2.2	3.8

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

Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the second quarter of 2017 (**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 6**).

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

HPICs 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 7** lists the average radiation exposure rates measured by the HPICs for second quarter 2017. **Table 8** lists the EIC monitoring results for second quarter 2017. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 6. Summary of instrumentation at radiation monitoring stations.

Station Location	Instrument Type	
	HPIC	EIC
On-site Locations		
Base of Howe	■	■
Big Lost River Rest Area	■	■
Experimental Field Station		■
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 7. Average gamma exposure rates, second quarter, 2017, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	15.7	1.3
Big Lost River Rest Area	15.2	1.2
Main Gate	14.6	0.8
[1]Rover	--	--
Sand Dunes Tower	13.2	0.9
Boundary Locations		
Atomic City	12.8	1.1
Big Southern Butte	15.0	1.2
Howe Met Tower	12.7	0.9
Monteview	13.4	1.3
Mud Lake / Terreton	14.2	1.3
Distant Locations		
Fort Hall	12.9	2.0
Idaho Falls	12.5	1.3

[1]Rover location HPIC electronics had various electronic malfunctions and/or extreme temperature interference and the data was therefore unusable; no data is available for second quarter 2017 at this location.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, second quarter, 2017.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	10.4, 10.7	
Big Lost River Rest Area	13.2	0.6
Experimental Field Station	15.9	2.2
Main Gate	14.7	0.6
Rover	14.4	2.5
Sand Dunes Tower	15.3	2.0
Van Buren Avenue	13.8	1.0
Boundary Locations		
Atomic City	13.8	2.8
Big Southern Butte	18.7	2.1
Howe Met Tower	10.0	0.8
Monteview	13.0	2.7
Mud Lake/Terreton	14.0	2.7
Distant Locations		
Craters of the Moon	12.1	2.1
Fort Hall	13.3	2.3
Idaho Falls	10.1, 10.7	

[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 in order to identify INL impacts on the Eastern Snake River Plain Aquifer (ESRPA), evaluate trends of known INL contaminants and other general groundwater quality indicators, and verify DOE and USGS monitoring results. Most samples are collected from groundwater (wells and springs); a few each year are also collected from surface water (streams) and wastewater. Most sites sampled by DEQ-INL OP are sampled concurrently with a DOE contractor or the USGS. DEQ-INL OP annually compares its own analytical results with those obtained by co-samplers to evaluate consistency.

Each sample site is categorized as up-gradient, facility, boundary, distant, surface water, or wastewater depending on its location (**Figure 2 and Figure 3**). Up-gradient sites are situated north and northeast of INL facilities and have not been affected by INL operations. Facility sites are near facility complexes within the INL, including the Idaho Nuclear Technology and Engineering Center (INTEC), the Advanced Test Reactor Complex (ATR), Test Area North (TAN), the Radioactive Waste Management Complex (RWMC), the Central Facilities Area (CFA), and the Naval Reactors Facility (NRF). Many facility sites are in areas of known contamination and are sampled to monitor trends of specific contaminants. Boundary sites are on or near the southern boundary of the INL, down-gradient of potential sources of INL contamination. Distant sites are farther down-gradient of the INL and include wells and springs used for agricultural, municipal, domestic, and industrial purposes. Surface water and wastewater sites are in various locations and are monitored because they are current sources of recharge to the aquifer.

Samples collected from water monitoring sites are analyzed for various radiological and non-radiological constituents, many of which are present in the aquifer both naturally and as a result of INL operations. Concentrations of gross alpha and gross beta radioactivity, gamma-emitting radionuclides, tritium, common ions, dissolved trace metals, and nutrients are measured at all locations. Select sites are also sampled for specific radionuclides—including isotopes of uranium (^{234}U, ^{235}U, and ^{238}U) and plutonium (^{238}Pu, $^{239/240}$Pu), americium-241 (^{241}Am), strontium-90 (^{90}Sr), and technetium-99 (^{99}Tc)—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 may be collected and analyzed for specific radionuclides.

During the second quarter of 2017, four up-gradient, twenty-two facility, five boundary, and five distant locations were sampled. Analytical results are reported in **Tables 9 - 20** and summarized below.

Gross alpha radioactivity was detected at three up-gradient, twelve facility, three boundary, and four distant locations (**Table 9**). All detectable concentrations were consistent with historical trends, and concentrations at all up-gradient, boundary, and distant locations and most facility locations were within the range of naturally occurring background concentrations determined by historical DEQ data. No location had a gross alpha concentration that exceeded the EPA drinking water maximum contaminant level (MCL) for alpha particles of 15 pCi/L.

Gross beta radioactivity was detected at all but one location sampled this quarter (**Table 9**). All up-gradient and boundary locations and all but one distant location had concentrations within the naturally occurring background range determined by historical DEQ data. One distant site, Alpheus Spring, had a gross beta concentration slightly above background; however, a duplicate sample from this location had a much lower concentration, resulting in qualification of the original result as an estimate. Several facility sample sites at INTEC, TAN, and ATR had elevated gross beta concentrations, with a maximum of 1117 ± 15 pCi/L measured at TAN-37A ('A' denotes the shallowest sampling depth, 240 feet below the surface, in well TAN-37). These concentrations are consistent with historical trends and have been attributed to past INL waste disposal practices. The MCL for beta and gamma radioactivity is 4 mrem/year, which is 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.

Manmade, gamma-emitting ^{137}Cs was detected in well TAN-37A at a concentration of 17.0 ± 2.6 pCi/L (**Table 9**). Cesium-137 has been detected in TAN-37A at slightly lower concentrations several times previously, with the previous maximum being 12.6 ± 3.6 pCi/L in 2014. The elevated concentration measured this quarter is probably a side-effect of in situ bioremediation (ISB) treatment of the TAN VOC plume, which resumed at a nearby well in 2016 (DOE/ID-11561). No other location had a detectable concentration of ^{137}Cs or any other manmade gamma-emitting nuclide.

Nine facility locations—five at INTEC, three at TAN, and one at ATR—were sampled for uranium isotopes. All had detectable concentrations of ^{234}U and ^{238}U (**Table 10**). Wells ICPP-2020 at INTEC, TAN-28, TAN-29, and TAN-37A at TAN, and USGS-065 at ATR had detectable ^{235}U concentrations. Most detections were slightly above naturally occurring background concentrations, and all were consistent with historical observations. Six facility locations—five at INTEC and one at ATR—were sampled for plutonium isotopes. No plutonium isotopes were detected (**Table 11**). One site at ATR was sampled for ^{241}Am this quarter. No ^{241}Am was detected (**Table 12**).

Twenty facility locations were sampled for ^{90}Sr. Detectable concentrations were found in thirteen samples from INTEC, ATR, and TAN, with a maximum concentration of 398 ± 94 pCi/L at TAN-37A (**Table 13**). Nine locations had ^{90}Sr concentrations above the drinking water MCL of 8 pCi/L. All

elevated concentrations were measured in samples from areas of known contamination and are consistent with historical trends.

Three up-gradient and seven facility locations were sampled for ^{99}Tc. All had detectable concentrations of ^{99}Tc (**Table 14**). As in previous years, the highest concentrations were found at INTEC wells ICPP-2020, USGS-052, and USGS-067, with a maximum of 278.3 ± 1.5 pCi/L at USGS-052. All detections were consistent with historical data, and elevated concentrations were from areas of known contamination. All concentrations were below the drinking water MCL of 900 pCi/L. The three up-gradient locations, which should have no ^{99}Tc, were sampled as part of an ongoing internal study to determine whether low-level ^{99}Tc detections result from analytical interference by naturally occurring beta activity.

Tritium concentrations are analyzed in water samples collected by DEQ-INL OP using two different methods. Samples from all locations are analyzed using the standard method, which has an MDC of about 130 pCi/L. Selected locations at which tritium levels are too low to be detected by the standard method are re-analyzed using an electrolytic enrichment method, which has an MDC of about 10-14 pCi/L. Using the standard method, tritium was detected at fifteen facility sites this quarter, located at INTEC, ATR, TAN, CFA, and RWMC (**Table 15**). All concentrations were consistent with historical data and were measured in areas of known contamination related to past INL waste disposal practices. Tritium was not detected at any up-gradient, boundary, or distant location using the standard method. No samples collected during the current quarter were analyzed using the enrichment method; however, analyses for twelve samples collected in previous quarters were completed and are presented in **Table 16**. The results of all enriched analyses are consistent with historical trends at these locations. A backlog of 77 samples to be analyzed by the enrichment method remains.

Samples from all locations were analyzed for metals, common ions, and nutrients. Results are shown in **Tables 17, 18,** and **19**. All results were within expected ranges at each location, with the exceptions of iron at TAN-37A and manganese at TAN-28, TAN-29, and TAN-37A, which increased substantially compared to 2016. This increase is probably the result of reducing conditions created in the aquifer by ISB injections that resumed in 2016 at well TAN-2272 (up-gradient of wells TAN-28, TAN-29, and TAN-37A), and was predicted in DEQ-INL OP's Annual Report for 2016.

Four facility locations—three at TAN and one at RWMC—were sampled for VOCs. All had detectable concentrations of at least three VOCs. All VOC detections were consistent with historical data and were measured in areas of known contamination. **Table 20** shows VOCs that were detected in at least one location. A complete list of VOC analytes is shown in **Appendix C**.

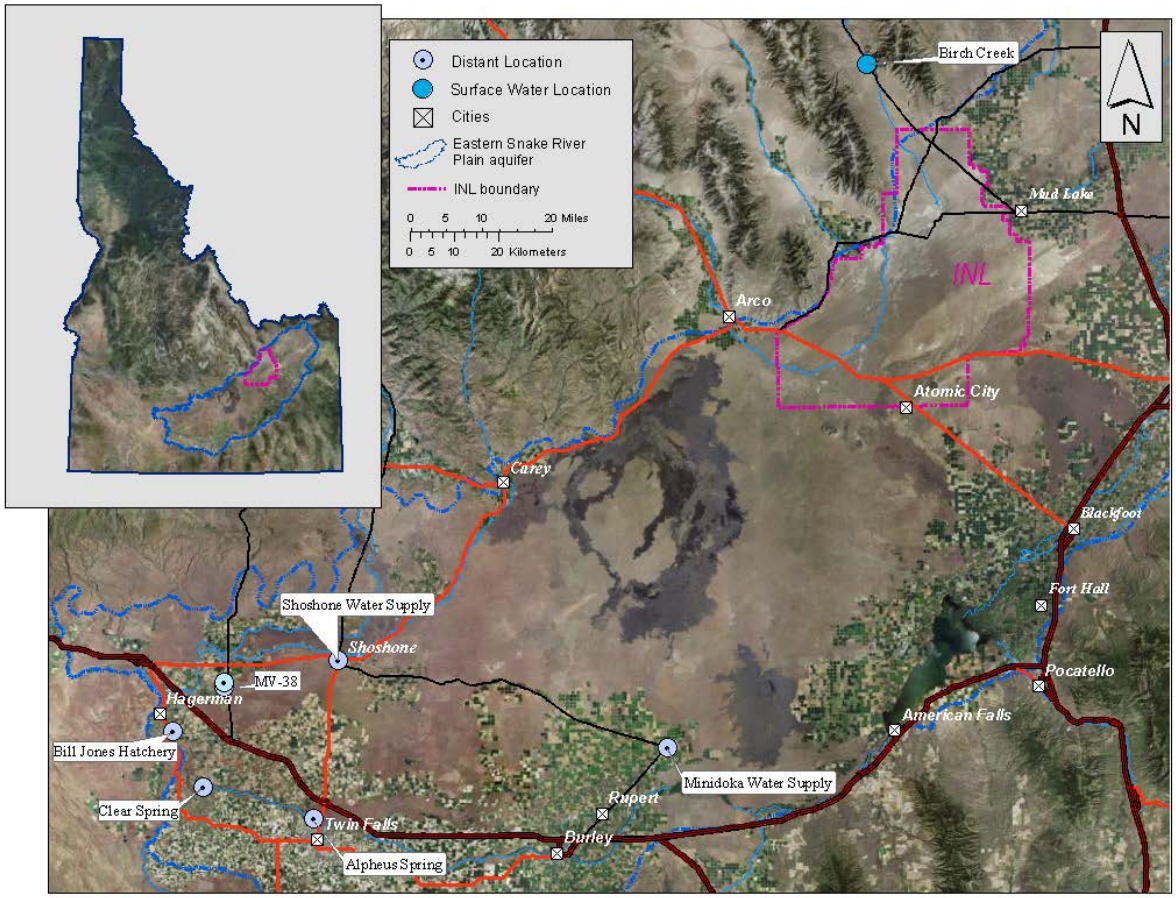

Figure 2. Distant and Surface Water monitoring locations.

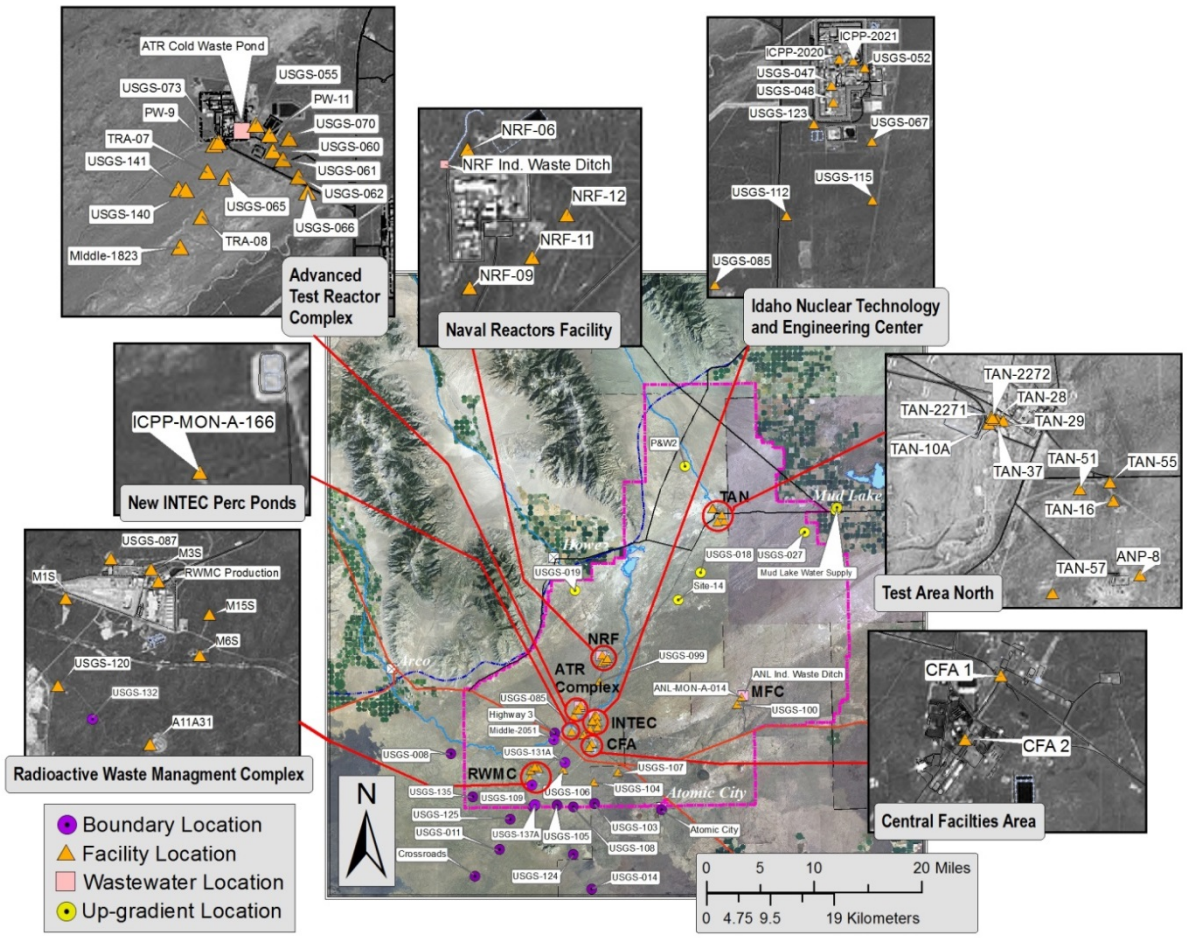

Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

Table 9. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations (pCi/L) for water samples, second quarter, 2017.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Man-made gamma-emitting radionuclide Cesium-137		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Upgradient										
Mud Lake Water Supply	5/22/2017	1.5		0.6	2.9		0.8	-0.7	U	1.6
P&W-2	4/25/2017	1.7		0.9	2.1		0.8	0.2	U	1.3
USGS-019	4/25/2017	1.1	U	1.0	1.1	U	0.8	0.1	U	1.8
USGS-027	4/25/2017	2.8		1.4	7.4		1.1	-0.9	U	1.6
Facility										
CFA 1	4/24/2017	-0.3	U	1.2	9.2		1.1	-0.2	U	2.1
ICPP-2020	5/4/2017	4.1		1.4	179.6		3.4	1.5	U	1.7
ICPP-MON-A-166	4/24/2017	0.8	U	0.9	3.4		0.8	1.1	U	1.6
NRF-06	5/9/2017	5.6	U	3.9	7.6		3.9	-0.7	U	1.2
NRF-09	5/9/2017	3.8		1.7	3.3		1.4	-0.2	U	1.2
NRF-11	5/9/2017	2.4		1.4	3.6		1.4	0.8	U	1.4
NRF-12	5/9/2017	3.1		1.4	2.1		1.0	0.2	U	2.0
TAN-28	4/17/2017	8.9		2.9	520.7		7.8	-0.8	U	2.6
TAN-29	4/17/2017	4.7		2.1	59.2		2.7	1.1	U	2.3
TAN-37A	4/17/2017	5.4	U	3.8	1117		15	17.0		2.6
USGS-047	5/4/2017	2.8		1.1	43.0		1.8	1.9	U	1.4
USGS-048	5/4/2017	1.5		1.0	28.3		1.5	0.9	U	1.4
USGS-052	5/8/2017	2.2		1.1	167.9		3.1	2.0	U	2.4
USGS-055	4/5/2017	0.6	U	1.2	85.7		2.4	0.2	U	1.1
USGS-061	4/5/2017	0.9	U	1.1	4.4		1.0	0.1	U	2.5
USGS-062	4/5/2017	2.2	U	1.6	7.9		1.1	0.5	U	1.5
USGS-065	4/6/2017	1.8	U	1.3	4.7		1.0	0.0	U	2.2
USGS-067	5/8/2017	3.1		1.2	100.5		2.6	0.1	U	1.1
USGS-070	4/6/2017	2.3		1.3	57.1		2.0	-1.0	U	1.4
USGS-085	4/10/2017	1.9		1.2	10.1		1.1	0.2	U	3.0
USGS-087	4/20/2017	1.0	U	0.9	4.4		0.9	1.2	U	1.7
USGS-100	4/24/2017	0.7	U	0.9	4.2		0.9	1.9	U	1.4
Boundary										
Atomic City	4/19/2017	0.6	U	0.9	3.2		0.8	0.7	U	2.0
Crossroads	4/20/2017	2.1		1.0	2.7		0.8	0.0	U	2.2
USGS-008	4/20/2017	2.8		1.1	1.7		0.9	0.0	U	2.4
USGS-011	4/19/2017	1.8		1.0	2.1		0.8	0.7	U	2.2
USGS-124	4/19/2017	0.8	U	1.0	4.4		0.9	0.4	U	1.2
Distant										
Alpheus Spring	5/16/2017	6.0		1.9	10.2	J	1.4	0.5	U	1.4
Bill Jones Hatchery	5/16/2017	0.8	U	0.8	3.4		0.9	-0.8	U	2.0
Clear Spring	5/16/2017	2.8		1.3	3.9		1.0	-0.3	U	1.4
Minidoka Water Supply	5/16/2017	1.4		0.9	2.7		1.0	0.2	U	1.6
Shoshone Water Supply	5/16/2017	2.4		1.0	2.2		1.0	0.0	U	1.5

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

Table 10. Uranium isotopes concentrations (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Facility										
ICPP-2020	5/4/2017	1.51		0.35	0.047	J*	0.047	0.82		0.23
TAN-28	4/17/2017	8.5		1.5	0.44		0.16	1.17		0.28
TAN-29	4/17/2017	6.5		1.2	0.23		0.11	1.26		0.30
TAN-37A	4/17/2017	6.2		1.1	0.21		0.11	0.95		0.25
USGS-047	5/4/2017	1.57		0.37	0.061	U	0.060	0.59		0.19
USGS-048	5/4/2017	1.56		0.37	0.047	U	0.053	0.68		0.21
USGS-052	5/8/2017	1.65		0.38	0.046	U	0.052	0.71		0.21
USGS-065	4/6/2017	2.25		0.46	0.109		0.071	1.03		0.26
USGS-067	5/8/2017	1.37		0.34	0.090	U	0.079	0.64		0.21

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*Result is considered an estimate because it is less than 3xSD but greater than or equal to 2xSD.

Table 11. Plutonium isotopes concentrations (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240		
		Concentration		2 SD	Concentration		2 SD
Facility							
ICPP-2020	5/4/2017	-0.004	U	0.016	0.007	U	0.016
USGS-047	5/4/2017	0	U	0.019	0.005	U	0.019
USGS-048	5/4/2017	-0.006	U	0.019	0.010	U	0.019
USGS-052	5/8/2017	0.025	U	0.037	-0.008	U	0.037
USGS-065	4/6/2017	-0.007	U	0.019	-0.007	U	0.018
USGS-067	5/8/2017	0	U	0.019	0.006	U	0.019

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

Table 12. Americium-241 concentration (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Americium-241		
		Concentration		2 SD
Facility				
USGS-065	4/6/2017	-0.011	U	0.016

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

Table 13. Strontium-90 concentrations (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Facility				
CFA 1	4/24/2017	0.06	U	0.23
ICPP-2020	5/4/2017	10.7		2.6
NRF-06	5/9/2017	-0.16	U	0.25
NRF-09	5/9/2017	-0.26	U	0.38
NRF-11	5/9/2017	-0.20	U	0.25
NRF-12	5/9/2017	-0.09	U	0.22
TAN-28	4/17/2017	185		43
TAN-29	4/17/2017	18.6		4.5
TAN-37A	4/17/2017	398		94
USGS-047	5/4/2017	16.3		3.9
USGS-048	5/4/2017	9.9		2.4
USGS-052	5/8/2017	2.57		0.74
USGS-055	4/5/2017	29.0		6.9
USGS-061	4/5/2017	0.58		0.31
USGS-062	4/5/2017	1.00		0.38
USGS-065	4/6/2017	-0.05	U	0.24
USGS-067	5/8/2017	11.0		2.7
USGS-070	4/6/2017	16.5		4.0
USGS-085	4/10/2017	2.07		0.59
USGS-087	4/20/2017	0.20	U	0.28

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. Technetium-99 concentrations (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Upgradient				
P&W-2	4/25/2017	0.4		0.2
USGS-019	4/25/2017	0.5		0.2
USGS-027	4/25/2017	1.4		0.2
Facility				
CFA 1	4/24/2017	8.3		0.3
ICPP-2020	5/4/2017	236.8		1.4
USGS-047	5/4/2017	1.5		0.2
USGS-048	5/4/2017	2.8		0.2
USGS-052	5/8/2017	278.3		1.5
USGS-067	5/8/2017	110.5		1.0
USGS-085	4/10/2017	1.0		0.2

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

Table 15. Tritium concentrations (pCi/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Upgradient				
Mud Lake Water Supply	5/22/2017	-140	U	160
P&W-2	4/25/2017	-30	U	170
USGS-019	4/25/2017	-20	U	130
USGS-027	4/25/2017	-20	U	130
Facility				
CFA 1	4/24/2017	3170		260
ICPP-2020	5/4/2017	1740		230
ICPP-MON-A-166	4/24/2017	40	U	140
NRF-06	5/9/2017	-70	U	170
NRF-09	5/9/2017	50	U	130
NRF-11	5/9/2017	20	U	130
NRF-12	5/9/2017	-110	U	170
TAN-28	4/17/2017	850		190
TAN-29	4/17/2017	1330		210
TAN-37A	4/17/2017	700		190
USGS-047	5/4/2017	370		190
USGS-048	5/4/2017	1060		200
USGS-052	5/8/2017	380		190
USGS-055	4/5/2017	2320		230
USGS-061	4/5/2017	970		200
USGS-062	4/5/2017	140	U	170
USGS-065	4/6/2017	2500		240
USGS-067	5/8/2017	2400		260
USGS-070	4/6/2017	730		190
USGS-085	4/10/2017	990		200
USGS-087	4/20/2017	530		180
USGS-100	4/24/2017	110	U	170
Boundary				
Atomic City	4/19/2017	-20	U	210
Crossroads	4/20/2017	-70	U	170
USGS-008	4/20/2017	-50	U	130
USGS-011	4/19/2017	-40	U	130
USGS-124	4/19/2017	0	U	140
Distant				
Alpheus Spring	5/16/2017	30	U	130
Bill Jones Hatchery	5/16/2017	-130	U	160
Clear Spring	5/16/2017	-40	U	170
Minidoka Water Supply	5/16/2017	-50	U	170
Shoshone Water Supply	5/16/2017	-90	U	170

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. Enriched tritium concentrations (pCi/L) in water samples collected during various quarters and analyzed in the second quarter of 2017.

Sample Location	Sample Date	Enriched Tritium		
		Concentration		2 SD
Facility				
A11A31	11/3/2015	64		10
M15S	11/4/2015	87		8
M1S	11/2/2015	5	U	6
NRF-11	5/17/2016	14		6
USGS-120	10/21/2015	170		12
Boundary				
Highway 3	10/19/2015	64		9
USGS-125	10/21/2015	44		8
USGS-131A (812 ft bls)	6/29/2016	1012		27
Distant				
Bill Jones Hatchery	8/25/2016	3	U	10
Minidoka Water Supply	7/13/2015	8	U	6
MV-38	8/31/2016	14		5
Surface Water				
Birch Creek	10/14/2015	5	U	7

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

Table 17. Dissolved metals concentrations (µg/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Upgradient																	
P&W-2	4/25/2017	<2.0	U	45		1.7		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-019	4/25/2017	<2.0	U	78		1.6		<10	U	<1.0	U	8		<2.0	U	<10	U
USGS-027	4/25/2017	2.6		85		5.2		43		<1.0	U	3.4		2.1		<10	U
Facility																	
CFA 1	4/24/2017	<2.0	U	88		13		<10	U	1.4		<1.0	U	<2.0	U	<10	U
ICPP-2020	5/4/2017	<2.0	U	110		8.8		44		<1.0	U	8.8		<2.0	U	<10	U
ICPP-MON-A-166	4/24/2017	<2.0	U	51		4.7		12		<1.0	U	5.6		<2.0	U	<10	U
NRF-06	5/9/2017	3.3		140		45		<10	U	<1.0	U	<1.0	U	2.4		<10	U
NRF-09	5/9/2017	<2.0	U	150		12		<10	U	<1.0	U	<1.0	U	2.5		<10	U
NRF-11	5/9/2017	<2.0	U	140		11		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
NRF-12	5/9/2017	<2.0	U	140		9.4		<10	U	<1.0	U	<1.0	U	2.2		<10	U
TAN-28	4/17/2017	<2.0	U	360		1.1		11		<1.0	U	1200		<2.0	U	22	
TAN-29	4/17/2017	<2.0	U	250		<1	U	17		<1.0	U	180		<2.0	U	15	
TAN-37A	4/17/2017	3.9		460		7.2		5600		<1.0	U	1600		<2.0	U	<10	U
USGS-047	5/4/2017	<2.0	U	68		7.5		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-048	5/4/2017	<2.0	U	76		7.1		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-052	5/8/2017	<2.0	U	80		7.2		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-055	4/5/2017	7.8		82		18		29		<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-061	4/5/2017	<2.0	U	60		6.5		120		<1.0	U	18		<2.0	U	<10	U
USGS-062	4/5/2017	8.6		64		9		<10	U	<1.0	U	<1.0	U	2.2		<10	U
USGS-065	4/6/2017	<2.0	U	48		79		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-067	5/8/2017	<2.0	U	120		9.6	J	16		<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-070	4/6/2017	8.8		80		11		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-085	4/10/2017	<2.0	U	91		20		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-087	4/20/2017	<2.0	U	27		8.8		12		<1.0	U	5.2		<2.0	U	<10	U
USGS-100	4/24/2017	<2.0	U	36		3.5		17		<1.0	U	1.5		<2.0	U	<10	U
Boundary																	
Atomic City	4/19/2017	2.3		34		2.2		<10	U	1.2		<1.0	U	<2.0	U	35	
Crossroads	4/20/2017	<2.0	U	34		3.2		<10	U	<1.0	U	<1.0	U	<2.0	U	56	
USGS-008	4/20/2017	<2.0	U	80		2.6		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-011	4/19/2017	<2.0	U	51		3.8		13		<1.0	U	<1.0	U	<2.0	U	<10	U
USGS-124	4/19/2017	<2.0	U	30		5.8		30		<1.0	U	5.9		<2.0	U	<10	U

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. Common ion concentrations (mg/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Calcium[1]		Magnesium[1]		Sodium[1]		Potassium[1]		Fluoride		Chloride		Sulfate		Alkalinity[2]	
Upgradient																	
P&W-2	4/25/2017	40		16		8.4		1.7		0.212		8.99		30.6		140	
USGS-019	4/25/2017	45		17		9.8		1.4		<0.20	U	12.6		23.8		165	
USGS-027	4/25/2017	50		18		28		5.9		0.624		49.3		40.5		156	
Facility																	
CFA 1	4/24/2017	57		18		29		3.8		<0.20	U	87.7		33.6		126	
ICPP-2020	5/4/2017	59		17		20		3.0		0.248		56.9		38.0		139	
ICPP-MON-A-166	4/24/2017	34		12		9.6		2.7		0.293		13.5		19.7		122	
NRF-06	5/9/2017	130		34		180		6.0		<0.20	U	462		75.0		180	
NRF-09	5/9/2017	72		22		20		2.6		<0.20	U	54.1		42.0		201	
NRF-11	5/9/2017	67		21		18		2.4		<0.20	U	41.0		38.5		201	
NRF-12	5/9/2017	66		21		16		2.4		<0.20	U	37.8		38.8		202	
TAN-28	4/17/2017	87		33		70		5.5		<0.20	U	112		39.3		342	
TAN-29	4/17/2017	69		20		56		5.2		<0.20	U	96.0		41.4		227	
TAN-37A	4/17/2017	95		55		130		12		<0.20	U	116		66.5		587	
USGS-047	5/4/2017	48		13		9.6		2.0		0.258		15.7		23.9		151	
USGS-048	5/4/2017	47		13		12		2.3		0.238		20.1		25.1		149	
USGS-052	5/8/2017	46		14		11		2.5		0.239		19.9		25.3		148	
USGS-055	4/5/2017	69		20		15		2.9		0.231		16.3		93.4		166	
USGS-061	4/5/2017	78		17		12		2.2		<0.20	U	17.4		118		147	
USGS-062	4/5/2017	92		27		16		3.3		0.240		23.0		200		136	
USGS-065	4/6/2017	84		18		14		3.2		<0.20	U	19.6		156		125	
USGS-067	5/8/2017	50		14		22		3.3		0.265		45.1		28.7		139	
USGS-070	4/6/2017	70		21		14		3.2		0.239		16.5		108		153	
USGS-085	4/10/2017	55		15		10		2.4		0.204		14.0		43.9		128	
USGS-087	4/20/2017	37		14		11		2.9		0.225		18.3		25.7		128	
USGS-100	4/24/2017	36		12		16		3.2		0.740		16.3		17.4		131	
Boundary																	
Atomic City	4/19/2017	34		13		17		3.4		0.618		17.4		17.7		134	
Crossroads	4/20/2017	40		14		7.4		2.2		0.222		9.09		21.7		142	
USGS-008	4/20/2017	46		15		6.8		1.7		0.202		7.87		22.8		156	
USGS-011	4/19/2017	40		14		8.1		2.2		0.245		9.91		23.3		140	
USGS-124	4/19/2017	40		16		10		2.4		0.378		16.7		24.3		140	

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.

[1]Samples analyzed for calcium, magnesium, sodium, and potassium were filtered in the field.

[2]As $CaCO_3$.

Table 19. Dissolved nutrient concentrations (mg/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	Nitrate + Nitrite		Phosphorus	
Upgradient					
P&W-2	4/25/2017	0.50		0.018	
USGS-019	4/25/2017	0.91		0.0064	
USGS-027	4/25/2017	2.5		0.014	
Facility					
CFA 1	4/24/2017	2.7		0.020	
ICPP-2020	5/4/2017	4.4		0.021	
ICPP-MON-A-166	4/24/2017	0.27		0.024	
NRF-06	5/9/2017	2.1		0.091	
NRF-09	5/9/2017	2.9		0.030	
NRF-11	5/9/2017	2.2		0.030	
NRF-12	5/9/2017	2.2		0.029	
TAN-28	4/17/2017	0.43		0.091	J+
TAN-29	4/17/2017	0.68		0.043	J+
TAN-37A	4/17/2017	<0.01	U	0.70	
USGS-047	5/4/2017	2.4		0.035	
USGS-048	5/4/2017	2.3		0.031	
USGS-052	5/8/2017	1.8		NR	
USGS-055	4/5/2017	1.8		0.28	
USGS-061	4/5/2017	1.3		0.027	
USGS-062	4/5/2017	1.8		0.14	
USGS-065	4/6/2017	1.5		0.025	
USGS-067	5/8/2017	5.1		0.028	
USGS-070	4/6/2017	1.7		0.28	
USGS-085	4/10/2017	1.0		0.027	
USGS-087	4/20/2017	0.7		0.015	J+
USGS-100	4/24/2017	2.0		0.016	
Boundary					
Atomic City	4/19/2017	1.6		0.015	J+
Crossroads	4/20/2017	0.78		0.019	J+
USGS-008	4/20/2017	0.99		0.016	J+
USGS-011	4/19/2017	0.72		0.018	J+
USGS-124	4/19/2017	0.86		0.016	J+

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.
NR = Analysis not requested.

Table 20. Volatile organic compound concentrations (µg/L) in water samples, second quarter, 2017.

Sample Location	Sample Date	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Carbon tetrachloride	Chloro-methane	1,1-DCA
TAN-28	4/17/2017	2.08	308	0.66 J+	42.7	78.2	4.94 J+	<0.50 U	<0.50 U	0.61
TAN-29	4/17/2017	14.7	591	1.21 J+	140 J+	43.9	9.12 J+	<0.50 U	<0.50 U	0.98
TAN-37A	4/17/2017	<0.50 U	5.75	<0.50 U	5.51	80.8 J+	3.80 J+	<0.50 U	<0.50 U	<0.50 U
USGS-087	4/20/2017	<0.50 U	1.19	<0.50 U	<0.50 U	<0.50 U	<0.50 U	4.22	0.53	<0.50 U

Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane.
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.

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 second calendar quarter of 2017.

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, second quarter, 2017.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Riverside	04/03/2017	1701	119	<MDC
	05/08/2017	1803	129	<MDC
	06/05/2017	1804	130	<MDC
Gooding/Glanbia	04/13/2017	1342	108	<MDC
	06/08/2017	1347	105	<MDC
Verification Samples[2]				
Rupert	04/03/2017	1342	109	<MDC
Howe	04/04/2017	1361	95	<MDC
Terreton	05/01/2017	1474	98	<MDC
Dietrich	05/02/2017	1376	110	<MDC
Rupert	06/05/2017	1469	98	<MDC
Idaho Falls	06/06/2017	1437	108	<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, 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 second quarter of 2017 for the DEQ-INL OP's ESP (Environmental Surveillance Program). 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 second quarter of 2017, the DEQ-INL OP submitted 102 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 second quarter of 2017 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 analyses results for radiological and non-radiological analytes in ground and surface water are presented in **Tables 26, 27, 28,** and **29**.

There were no anomalies observed from the assessment of field blank samples as measured by the analytical laboratories used by DEQ-INL OP for the second quarter of 2017.

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 analyses, 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 analyses, the RPD is calculated to compare duplicate samples if both results are greater than the sample-specific minimum detectable concentration (MDC). DEQ-INL OP also considers duplicate sample results with 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

Duplicate results for groundwater are presented in **Table 30** for radiological analyses and **Table 31**, **32**, and **33** for non-radiological analyses. One duplicate analysis for gross beta radioactivity and one duplicate analysis for dissolved chromium failed to pass DEQ-INL OP's acceptance criteria. Results for each of these samples were qualified as estimates and flagged with a "J." The results of samples analyzed together with these duplicates were consistent with historical data and were not qualified.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added in order 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 acceptable if the percent recovery is 100 ± 25%. If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample are qualified as low-biased estimates (J-), and below-MDC results are qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples are qualified as high-biased estimates (J+), and below-MDC results are qualified as undetected (U). If the percent recovery of a spiked sample is <50% or >150%, the results of all associated samples are 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).

During second quarter 2017, two spiked samples were created using deionized water and submitted for analysis of metals, common anions, and nutrients. Results and percent recoveries are presented in **Table 34**, **and Table 35.**. One analysis of total phosphorous failed to meet DEQ-INL OP's acceptance criteria, with a percent recovery of 149%. Phosphorous results in associated samples were qualified as high-biased estimates (J+). All other analytical results for spiked water samples had percent recoveries within the acceptable range.

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 second quarter 2017 are presented in **Table 36**. 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 second quarter of 2017 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 second quarter of 2017.

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 second quarter of 2017 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 second quarter of 2017, no DEQ-INL OP sampling equipment failed or was replaced. Service reliability for air sampling equipment for the second quarter of 2017 is summarized in **Table 37**.

Conclusion

All data collected for the second quarter of 2017 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, second quarter, 2017.

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	141	13	0	0	1	ISU-EML
		Gross beta	141	13	0	0	1	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	34	4	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	36	1	5	0	0	ISU-EML
		Gross beta	36	1	5	0	0	ISU-EML
		Gamma emitters	36	1	5	0	0	ISU-EML
		Tritium	36	1	5	0	0	ISU-EML
		Enriched tritium	12	5	2	0	0	ISU-EML
		Technetium-99	10	0	3	0	0	ISU-EML
		Radiochemical	36	0	5	0	0	ISU Sub
		Metals	30	1	4	2	0	IBL
		Common Ions	30	1	4	2	0	IBL
		Nutrients	30	1	4	2	0	IBL
		Volatile Organics	4	1	1	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	11	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	54	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total Analyses			**724**	**44**	**43**	**15**	**2**	
Total QC Analyses (blanks, duplicates, and spikes)			**102**					
QC Analyses as a percentage of total Test Analyses[3]			**14.1%**					
Percentage of usable data[4]			**99.7%**					

[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), second quarter, 2017.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
03/30/17	04/06/17	2020	0.0	0.1	-0.2	0.5
04/06/17	04/13/17	2020	-0.1	0.1	0.5	0.5
04/13/17	04/20/17	2020	0.1	0.1	-0.2	0.5
04/20/17	04/27/17	2020	-0.1	0.1	-0.1	0.5
04/27/17	05/04/17	2020	0.0	0.1	0.2	0.5
05/04/17	05/10/17	2020	0.0	0.1	0.0	0.5
05/10/17	05/18/17	2020	0.1	0.1	0.3	0.5
05/18/17	05/25/17	2020	0.1	0.2	-0.5	0.5
05/25/17	06/01/17	2020	-0.1	0.1	-0.1	0.5
06/01/17	06/08/17	2020	0.0	0.1	-2.2	0.3
06/08/17	06/15/17	2020	0.0	0.1	-0.1	0.5
06/15/17	06/22/17	2020	0.1	0.1	-0.6	0.5
06/22/17	06/29/17	2020	-0.1	0.1	-0.3	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, composite samples, second quarter, 2017.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
07/20/17	1	31	52	21	69	115	2	10	17
Analysis Date	**Cesium-134**			**Cesium-137**		
	Concentration[1]	**± 2 SD**	**MDC**	**Concentration**	**± 2 SD**	**MDC**
07/20/17	1	2	5	1	4	6

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

Table 25. Blank analysis results for tritium in water vapor from air samples, second quarter, 2017.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP172ZTR01	06/19/17	06/26/17	07/30/17	-0.05	0.08	0.14
OP172ZTR02	07/05/17	07/10/17	07/30/17	-0.01	0.08	0.14
OP172ZTR03	07/05/17	07/12/17	07/20/17	0.01	0.11	0.18
OP172ZTR04	07/05/17	07/12/17	07/21/17	-0.05	0.08	0.14

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

Table 26. Blank analysis results (pCi/L) for radiological constituents in water, second quarter, 2017.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
171W001	4/17/2017	-0.3	0.2	0.4	Yes
Gross Beta					
171W001	4/17/2017	0.7	0.6	0.9	Yes
Cesium-137					
171W001	4/17/2017	-1.1	1.9	3.3	Yes
Tritium					
171W002	4/17/2017	0	130	150	Yes
Enriched Tritium					
151W105	4/20/2015	20	6	9	Yes*
151W832	10/20/2015	0	6	10	Yes
161W002	3/1/2016	18	7	12	Yes*
151W427	10/7/2015	15	7	11	Yes*
161W514	9/1/2016	20	6	9	Yes*

MDC = minimum detectable concentration.
* Detections in this range are typical of DI water.

Table 27. Blank analysis results (µg/L) for metals in groundwater and/or surface water, second quarter, 2017.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
171W004	4/17/2017	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	<10

Table 28. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, second quarter, 2017.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity[1]	Total Nitrogen	Total Phosphorus
171W003,004,005	4/17/2017	<0.10	<0.10	<0.10	<0.10	<0.20	<0.40	<0.80	<1.0	<0.010	<0.0050

[1] As $CaCO_3$.

Table 29. Blank analysis results (µg/L) for VOCs in groundwater and/or surface water, second quarter, 2017.

Sample Number	Sample Date	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Carbon tetrachloride	Chloro-methane	1,1-DCA
171W006	4/17/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane.

Table 30. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, second quarter, 2017.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	$\lvert R_1-R_2 \rvert$	$3(S_1^2+S_2^2)^{1/2}$	Within Criteria?[1]
Gross Alpha									
USGS-019	171W135	1.1	1.0	171W102	1.9	1.1	0.8	2.2	Yes
USGS-067	171W346	3.1	1.2	171W356	2.7	1.2	0.4	2.5	Yes
USGS-085	171W156	1.9	1.2	171W163	1.0	1.0	0.9	2.3	Yes
USGS-087	171W170	1.0	0.9	171W178	1.4	0.9	0.4	1.9	Yes
Alpheus Spring	171W249	6.0	1.9	171W251	2.5	1.4	3.5	3.5	Yes
Gross Beta									
USGS-019	171W135	1.1	0.8	171W102	1.5	0.8	0.4	1.7	Yes
USGS-067	171W346	100.5	2.6	171W356	102.9	2.6	2.4	5.5	Yes
USGS-085	171W156	10.1	1.1	171W163	8.7	1.1	1.4	2.3	Yes
USGS-087	171W170	4.4	0.9	171W178	3.2	0.9	1.2	1.9	Yes
Alpheus Spring	171W249	10.2	1.4	171W251	6.7	1.2	3.5	2.8	No
Cesium-137									
USGS-019	171W135	0.1	1.8	171W102	-1.0	1.4	1.1	3.4	Yes
USGS-067	171W346	0.1	1.1	171W356	0.2	1.3	0.1	2.6	Yes
USGS-085	171W156	0.2	3.0	171W163	0.9	2.1	0.7	5.5	Yes
USGS-087	171W170	1.2	1.7	171W178	-0.4	1.4	1.6	3.3	Yes
Alpheus Spring	171W249	0.5	1.4	171W251	1.0	2.3	0.5	4.0	Yes
Tritium									
USGS-019	171W137	-20	130	171W105	-80	130	60	276	Yes
USGS-067	171W351	2400	260	171W361	2150	230	250	521	Yes
USGS-085	171W159	990	200	171W166	980	200	10	424	Yes
USGS-087	171W173	530	180	171W181	560	180	30	382	Yes
Alpheus Spring	171W250	30	130	171W252	40	130	10	276	Yes
Enriched Tritium									
M1S	151W888	5	6	151W899	-2	6	7	13	Yes
USGS-120	151W797	170	12	151W807	153	12	17	25	Yes
Strontium-90									
USGS-067	171W349	11.0	2.7	171W359	10.6	2.6	0.4	5.6	Yes
USGS-085	171W157	2.07	0.59	171W164	2.46	0.68	0.39	1.35	Yes
USGS-087	171W171	0.20	0.28	171W179	0.16	0.25	0.04	0.56	Yes
Technetium-99									
USGS-019	171W104	0.4	0.2	171W136	0.5	0.2	0.1	0.4	Yes
USGS-067	171W350	110.5	1.0	171W360	110.7	1.0	0.2	2.1	Yes
USGS-085	171W158	1.0	0.2	171W165	1.0	0.2	0.0	0.4	Yes
Plutonium-238									
USGS-067	171W348	0	0.019	171W358	-0.006	0.018	0.006	0.039	Yes
Plutonium-239/240									
USGS-067	171W348	0.006	0.019	171W358	0.008	0.018	0.002	0.039	Yes
Uranium-234									
USGS-067	171W352	1.37	0.34	171W362	1.54	0.37	0.17	0.75	Yes
Uranium-235									
USGS-067	171W352	0.090	0.079	171W362	0.034	0.057	0.056	0.146	Yes
Uranium-238									
USGS-067	171W352	0.64	0.21	171W362	0.82	0.24	0.18	0.48	Yes

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

Table 31. Duplicate results for metals (µg/L) in groundwater, second quarter, 2017.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
USGS-019	171W139	4/25/2017	<2.0	78	1.6	<10	<1.0	8.0	<2.0	<10
USGS-019	171W107	4/25/2017	<2.0	79	1.6	<10	<1.0	8.0	<2.0	<10
RPD			**0**	**-1**	**0**	**0**	**0**	**0**	**0**	**0**
USGS-067	171W354	5/8/2017	<2.0	120	9.6	16	<1.0	<1.0	<2.0	<10
USGS-067	171W364	5/8/2017	<2.0	110	6.9	<10	<1.0	<1.0	<2.0	<10
RPD			**0**	**9**	**33**	**46***	**0**	**0**	**0**	**0**
USGS-085	171W161	4/10/2017	<2.0	91	20	<10	<1.0	<1.0	<2.0	<10
USGS-085	171W168	4/10/2017	<2.0	88	21	<10	<1.0	<1.0	<2.0	<10
RPD			**0**	**3**	**-5**	**0**	**0**	**0**	**0**	**0**
USGS-087	171W175	4/20/2017	<2.0	27	8.8	12	<1.0	5.2	<2.0	<10
USGS-087	171W183	4/20/2017	<2.0	27	8.7	<10	<1.0	5.1	<2.0	<10
RPD			**0**	**0**	**1**	**18**	**0**	**2**	**0**	**0**

Relative Percent Difference (RPD) = $(R_1-R_2) / ((R_1+R_2)/2)*100$

* Sample passes criteria because at least one result is less than five times the MDC and $|R_1-R_2|$ is less than the MDC.

Table 32. Duplicate results for common ions and nutrients (mg/L) in groundwater, second quarter, 2017.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity[1]	Total Nitrogen	Total Phosphorus
USGS-019	171W139,138	4/25/2017	45	17	9.8	1.4	<0.20	12.6	23.8	165	0.91	0.0064
USGS-019	171W107,106	4/25/2017	45	17	9.8	1.4	<0.20	12.6	23.7	163	0.90	0.0073
RPD			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**-13**
USGS-067	171W354,353	5/8/2017	50	14	22	3.3	0.265	45.1	28.7	139	5.1	0.028
USGS-067	171W364,363	5/8/2017	50	14	22	3.3	0.271	45.4	28.7	139	5.1	0.028
RPD			**0**	**0**	**0**	**0**	**-2**	**-1**	**0**	**0**	**0**	**0**
USGS-085	171W161,160	4/10/2017	55	15	10	2.4	0.204	14.0	43.9	128	1.0	0.027
USGS-085	171W168,167	4/10/2017	56	15	10	2.4	0.201	14.0	43.9	126	1.0	0.026
RPD			**-2**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**4**
USGS-087	171W175,174	4/20/2017	37	14	11	2.9	0.225	18.3	25.7	128	0.70	0.015 J+[2]
USGS-087	171W183,182	4/20/2017	37	14	10	2.9	0.238	18.3	25.7	128	0.70	0.016 J+[2]
RPD			**0**	**0**	**10**	**0**	**-6**	**0**	**0**	**0**	**0**	**-6**

Relative Percent Difference (RPD) = $(R_1-R_2) / ((R_1+R_2)/2)*100$

[1] As $CaCO_3$.

[2] Result qualified as a high-biased estimate due to high percent recovery in an associated spike sample.

Table 33. Duplicate results for VOCs (µg/L) in groundwater, second quarter, 2017.

Sample Location	Sample Number	Sample Date	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Carbon tetrachloride	Chloro-methane	1,1-DCA
USGS-087	171W177	4/20/2017	<0.50	1.19	<0.50	<0.50	<0.50	<0.50	4.22	0.53	<0.50
USGS-087	171W185	4/20/2017	<0.50	1.25	<0.50	<0.50	<0.50	<0.50	4.16	<0.50	<0.50
RPD			**0**	**-5**	**0**	**0**	**0**	**0**	**1**	**6**	**0**

Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane.

Relative Percent Difference (RPD) = $(R_1-R_2) / ((R_1+R_2)/2)*100$.

Table 34. De-ionized water spike results (in µg/L) and percent recovery for metals in groundwater and/or surface water, second quarter, 2017.

Spike Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
171W022	4/18/2017	51.4	53	**103**	13.0	13	**100**	6.73	7.5	**111**	7.22	7.6	**105**	26.3	29	**110**
171W010	5/2/2017	83.9	87	**104**	10.5	10	**95**	5.44	5.8	**107**	5.84	6.2	**106**	21.2	22	**104**

[1] A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 35. De-ionized water spike results (mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, second quarter, 2017.

Spike Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
171W022,021,023	4/18/2017	15.9	16	**101**	4.05	4.1	**101**	8.29	8.3	**100**	1.66	1.7	**102**	0.978	0.974	**100**
171W010,009,011	5/2/2017	26.0	25	**96**	6.60	6.4	**97**	13.5	13	**96**	2.71	2.6	**96**	0.836	0.779	**93**

[1] A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 35. continued. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, second quarter, 2017.

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity[2]			Total Nitrogen			Total Phosphorus		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
171W022,021,023	4/18/2017	56.9	58.2	**102**	31.4	31.6	**101**	119	117	**98**	2.28	2.2	**96**	0.0222	0.033	**149**
171W010,009,011	5/2/2017	87.1	87.2	**100**	46.0	45.4	**99**	30.9	31	**100**	3.41	3.5	**103**	0.0266	0.025	**94**

[1] A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.
[2] As $CaCO_3$.

Table 36. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), second quarter, 2017.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SHY855	40.0	2.0	38.3	1.4	95.7	Y
SHY823	40.0	2.0	38.6	1.4	96.5	Y
SIR758	40.0	2.0	35.0	1.4	87.5	Y
				Triplicate AVG:	**93.2**	**Y**
SHC766	30.0	1.5	28.5	1.3	95.0	Y
SHY865	30.0	1.5	29.8	1.4	99.3	Y
SIR623	30.0	1.5	27.0	1.4	90.1	Y
				Triplicate AVG:	**95.0**	**Y**
SIR463	21.0	1.1	17.6	1.4	83.6	Y
SIR467	21.0	1.1	19.5	1.4	92.8	Y
SIR553	21.0	1.1	18.1	1.4	86.2	Y
				Triplicate AVG:	**87.5**	**Y**

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

Table 37. Air sampling field equipment service reliability (percent operational), second quarter, 2017.

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

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

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

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, second quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	03/30/17	04/06/17	0.6	0.2	18.7	1.0
	04/06/17	04/13/17	1.0	0.2	28.3	1.2
	04/13/17	04/20/17	0.7	0.2	20.0	1.0
	04/20/17	04/27/17	0.2	0.2	13.6	0.9
	04/27/17	05/04/17	1.0	0.2	21.0	1.0
	05/04/17	05/10/17	0.8	0.2	28.1	1.3
	05/10/17	05/18/17	1.2	0.2	26.2	1.1
	05/18/17	05/25/17	0.8	0.2	29.8	1.2
	05/25/17	06/01/17	1.0	0.2	34.6	1.3
	06/01/17	06/08/17	1.4	0.3	41.8	1.4
	06/08/17	06/15/17	1.1	0.3	27.5	1.2
	06/15/17	06/22/17	1.0	0.2	27.0	1.2
	06/22/17	06/29/17	1.3	0.3	40.5	1.4
Experimental Field Station	03/30/17	04/06/17	0.5	0.2	13.3	0.9
	04/06/17	04/13/17	0.6	0.2	23.2	1.1
	04/13/17	04/20/17	1.0	0.2	14.9	1.0
	04/20/17	04/27/17	0.2	0.2	10.5	0.8
	04/27/17	05/04/17	1.1	0.3	16.8	1.0
	05/04/17	05/10/17	0.8	0.2	23.0	1.2
	05/10/17	05/18/17	0.9	0.2	19.5	1.0
	05/18/17	05/25/17	0.7	0.2	23.5	1.2
	05/25/17	06/01/17	1.0	0.3	27.5	1.2
	06/01/17	06/08/17	1.2	0.3	30.9	1.3
	06/08/17	06/15/17	0.7	0.2	19.7	1.0
	06/15/17	06/22/17	1.0	0.2	20.2	1.1
	06/22/17	06/29/17	1.0	0.3	27.3	1.2
Sand Dunes Tower	03/30/17	04/06/17	0.4	0.2	12.0	0.8
	04/06/17	04/13/17	0.6	0.2	17.9	0.9
	04/13/17	04/20/17	0.7	0.2	11.5	0.8
	04/20/17	04/27/17	0.1	0.1	8.3	0.7
	04/27/17	05/04/17	0.5	0.2	11.6	0.8
	05/04/17	05/10/17	NS[1]	NS[1]	NS[1]	NS[1]
	05/10/17	05/18/17	0.7	0.2	15.3	0.8
	05/18/17	05/25/17	0.4	0.2	15.8	0.9
	05/25/17	06/01/17	0.6	0.2	19.8	1.0
	06/01/17	06/08/17	0.8	0.2	24.3	1.1
	06/08/17	06/15/17	0.6	0.2	15.5	0.9
	06/15/17	06/22/17	0.5	0.2	15.0	0.9
	06/22/17	06/29/17	0.5	0.2	20.6	1.0

[1]NS – No sample – sampler not started previous week.

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, second quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	03/30/17	04/06/17	NS[1]	NS[1]	NS[1]	NS[1]
	04/06/17	04/13/17	0.6	0.2	21.5	1.0
	04/13/17	04/20/17	0.4	0.1	13.6	0.9
	04/20/17	04/27/17	0.2	0.2	9.7	0.8
	04/27/17	05/04/17	0.7	0.2	13.9	0.9
	05/04/17	05/10/17	0.7	0.2	20.8	1.1
	05/10/17	05/18/17	0.7	0.2	17.3	0.9
	05/18/17	05/25/17	0.7	0.2	19.1	1.0
	05/25/17	06/01/17	0.7	0.2	24.4	1.1
	06/01/17	06/08/17	0.9	0.2	28.0	1.2
	06/08/17	06/15/17	0.7	0.2	17.0	0.9
	06/15/17	06/22/17	0.9	0.2	18.2	1.0
	06/22/17	06/29/17	0.7	0.2	25.4	1.1
Boundary Locations						
Atomic City	03/30/17	04/06/17	0.4	0.2	13.5	0.9
	04/06/17	04/13/17	0.7	0.2	20.3	1.0
	04/13/17	04/20/17	0.5	0.2	12.7	0.8
	04/20/17	04/27/17	0.2	0.2	9.7	0.8
	04/27/17	05/04/17	0.5	0.3	11.5	1.2
	05/04/17	05/10/17	R[2]	R[2]	R[2]	R[2]
	05/10/17	05/18/17	0.9	0.2	18.6	0.9
	05/18/17	05/25/17	0.8	0.2	20.9	1.0
	05/25/17	06/01/17	0.6	0.3	19.8	1.2
	06/01/17	06/08/17	1.0	0.2	29.7	1.2
	06/08/17	06/15/17	0.8	0.2	19.0	1.0
	06/15/17	06/22/17	0.8	0.3	19.6	1.2
	06/22/17	06/29/17	0.6	0.2	26.7	1.2
Howe	03/30/17	04/06/17	0.6	0.2	11.8	0.9
	04/06/17	04/13/17	0.6	0.2	19.0	1.0
	04/13/17	04/20/17	0.9	0.2	13.3	0.9
	04/20/17	04/27/17	0.3	0.2	9.2	0.8
	04/27/17	05/04/17	0.6	0.2	12.5	0.9
	05/04/17	05/10/17	0.8	0.2	19.5	1.1
	05/10/17	05/18/17	0.5	0.2	17.0	0.9
	05/18/17	05/25/17	0.4	0.2	16.3	1.0
	05/25/17	06/01/17	0.8	0.2	22.1	1.1
	06/01/17	06/08/17	0.6	0.2	24.8	1.1
	06/08/17	06/15/17	0.8	0.2	17.3	1.0
	06/15/17	06/22/17	0.4	0.2	13.9	0.9
	06/22/17	06/29/17	0.7	0.2	22.2	1.1

[1]NS – No sample – Sampler not operating, restarted without incident.
[2]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, second quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	03/30/17	04/06/17	0.7	0.2	12.6	0.9
	04/06/17	04/13/17	1.0	0.2	20.4	1.1
	04/13/17	04/20/17	0.7	0.2	15.9	1.0
	04/20/17	04/27/17	0.3	0.2	11.3	0.8
	04/27/17	05/04/17	0.7	0.2	14.6	0.9
	05/04/17	05/10/17	1.0	0.3	25.1	1.3
	05/10/17	05/18/17	1.0	0.2	21.3	1.0
	05/18/17	05/25/17	0.7	0.2	20.9	1.1
	05/25/17	06/01/17	0.9	0.2	24.3	1.1
	06/01/17	06/08/17	0.9	0.2	29.7	1.2
	06/08/17	06/15/17	0.7	0.2	17.0	1.0
	06/15/17	06/22/17	0.6	0.2	21.2	1.1
	06/22/17	06/29/17	0.9	0.3	28.6	1.2
Mud Lake	03/30/17	04/06/17	0.9	0.2	19.4	1.0
	04/06/17	04/13/17	1.1	0.3	27.2	1.2
	04/13/17	04/20/17	1.1	0.2	23.0	1.1
	04/20/17	04/27/17	0.4	0.2	14.3	0.9
	04/27/17	05/04/17	1.1	0.2	21.0	1.1
	05/04/17	05/10/17	1.1	0.3	28.8	1.4
	05/10/17	05/18/17	1.4	0.2	26.5	1.1
	05/18/17	05/25/17	1.4	0.3	28.8	1.2
	05/25/17	06/01/17	1.4	0.3	39.7	1.4
	06/01/17	06/08/17	1.7	0.3	40.7	1.4
	06/08/17	06/15/17	1.1	0.3	24.1	1.1
	06/15/17	06/22/17	1.1	0.2	27.1	1.2
	06/22/17	06/29/17	1.3	0.3	36.5	1.4
Distant Locations						
Craters of the Moon	03/30/17	04/06/17	0.6	0.2	18.6	1.0
	04/06/17	04/13/17	0.7	0.2	23.7	1.1
	04/13/17	04/20/17	0.7	0.2	17.4	1.0
	04/20/17	04/27/17	0.3	0.2	12.0	0.8
	04/27/17	05/04/17	0.3	0.2	16.8	1.0
	05/04/17	05/10/17	1.1	0.3	26.2	1.3
	05/10/17	05/18/17	0.7	0.2	20.5	0.9
	05/18/17	05/25/17	0.7	0.2	24.4	1.1
	05/25/17	06/01/17	0.6	0.2	27.6	1.2
	06/01/17	06/08/17	1.0	0.2	38.9	1.3
	06/08/17	06/15/17	1.0	0.2	25.8	1.1
	06/15/17	06/22/17	0.7	0.2	22.7	1.1
	06/22/17	06/29/17	0.9	0.3	33.4	1.3

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, second quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	03/30/17	04/06/17	NS[3]	NS[3]	NS[3]	NS[3]
	04/06/17	04/13/17	NS[3]	NS[3]	NS[3]	NS[3]
	04/13/17	04/20/17	NS[3]	NS[3]	NS[3]	NS[3]
	04/20/17	04/27/17	NS[3]	NS[3]	NS[3]	NS[3]
	04/27/17	05/04/17	NS[3]	NS[3]	NS[3]	NS[3]
	05/04/17	05/10/17	NS[3]	NS[3]	NS[3]	NS[3]
	05/10/17	05/18/17	NS[3]	NS[3]	NS[3]	NS[3]
	05/18/17	05/25/17	NS[3]	NS[3]	NS[3]	NS[3]
	05/25/17	06/01/17	NS[3]	NS[3]	NS[3]	NS[3]
	06/01/17	06/08/17	NS[3]	NS[3]	NS[3]	NS[3]
	06/08/17	06/15/17	NS[3]	NS[3]	NS[3]	NS[3]
	06/15/17	06/22/17	NS[3]	NS[3]	NS[3]	NS[3]
	06/22/17	06/29/17	NS[3]	NS[3]	NS[3]	NS[3]
Idaho Falls - HVP 3804	03/30/17	04/06/17	0.7	0.2	16.9	1.0
	04/06/17	04/13/17	1.2	0.3	27.0	1.2
	04/13/17	04/20/17	1.2	0.2	18.7	1.0
	04/20/17	04/27/17	0.5	0.2	13.7	0.9
	04/27/17	05/04/17	0.9	0.2	18.4	1.0
	05/04/17	05/10/17	1.2	0.3	29.4	1.4
	05/10/17	05/18/17	1.5	0.3	24.0	1.1
	05/18/17	05/25/17	1.2	0.3	26.1	1.2
	05/25/17	06/01/17	1.0	0.3	30.6	1.3
	06/01/17	06/08/17	1.3	0.3	39.0	1.4
	06/08/17	06/15/17	1.1	0.3	25.1	1.2
	06/15/17	06/22/17	1.0	0.2	27.2	1.2
	06/22/17	06/29/17	1.0	0.3	36.4	1.4
Idaho Falls - HVP 4304[2]	03/30/17	04/06/17	0.4	0.2	10.6	0.8
	04/06/17	04/13/17	0.7	0.2	18.6	1.0
	04/13/17	04/20/17	0.7	0.2	12.1	0.9
	04/20/17	04/27/17	0.2	0.2	9.4	0.8
	04/27/17	05/04/17	0.5	0.2	10.6	0.8
	05/04/17	05/10/17	1.2	0.3	20.2	1.1
	05/10/17	05/18/17	1.0	0.2	18.4	0.9
	05/18/17	05/25/17	0.7	0.2	17.0	1.0
	05/25/17	06/01/17	0.8	0.2	24.5	1.1
	06/01/17	06/08/17	1.4	0.3	32.3	1.2
	06/08/17	06/15/17	0.7	0.2	16.8	1.0
	06/15/17	06/22/17	0.9	0.2	22.2	1.1
	06/22/17	06/29/17	0.8	0.3	30.3	1.3

[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.
[3] NS – Sampler out of service.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, second quarter, 2017.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	12.9	0.5
Craters of the Moon	12.1	2.1
Big Lost River Rest Area	13.2	0.6
Van Buren Avenue	13.8	1.0
Experimental Field Station	15.9	2.2
Main Gate	14.7	0.6
Atomic City	13.8	2.8
Taber	14.8	2.2
Blackfoot	12.5	3.4
Ft. Hall	13.3	2.3
Idaho Falls	10.1, 10.7	
Mud Lake/ Terreton	14.0	2.7
Monteview	13.0	2.7
Sand Dunes Tower	15.3	2.0
Howe Met. Tower	10.0	0.8
MP276 -20	15.0	3.2
MP274 -20	14.6	1.9
MP272 -20	11.0, 13.2	
MP270 -20	14.0, 15.4	
MP268 -20	13.4	1.4
MP266 -20	11.3, 12.9	
MP264 -20	12.7, 12.8	
MP270 -20/26	16.0	3.3
MP268 -20/26	14.1, 17.0	
MP266 -20/26	17.0	2.2
MP263 -20/26	14.7	3.6
MP261 -20/26	12.6	2.4
MP259 -20/26	12.4	0.3
MFC (EBR II)	12.3, 16.3	
EBR I	15.2	3.1
RWMC	14.5	3.2
CFA	16.1, 17.2	
CITRC (PBF)	13.7	1.6
INTEC	16.0	1.7
ATR (TRA)	14.3	0.6
NRF	14.9	1.5
TAN/SMC	11.9	2.7
Mud Lake Bank of Commerce	11.2	1.6
MP43-33	14.9	0.8
MP41-33	13.1, 13.7	
MP39-33	16.0, 17.2	
MP 37-33	12.2, 14.0	
MP35-33	12.8	0.9
MP33-33	13.3	2.7
MP31-33	13.8	2.8
MP29-33	14.9	2.0

Table B.1. continued. Results for all electret ionization chamber (EIC) locations, second quarter, 2017.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP27-33	12.5	2.5
MP25-33	12.6	2.0
MP23-33	11.1	1.1
Base of Howe	10.4, 10.7	
Rover	14.4	2.5
Hamer	11.9, 12.5	
Sugar City	15.2, 16.7	
Roberts	12.9	1.0
Big Southern Butte	18.7	2.1

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

Appendix C

Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples.

Analyte	Minimum detectable concentrations (MDC) (expressed in µg/L)
Benzene	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
1,4-Dichlorobenzene	0.5
1,2-Dichlorobenzene	0.5
1,2-Dichloroethane	0.5
1,1-Dichloroethene	0.5
cis-1,2-Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
Ethylbenzene	0.5
Methylene Chloride	0.5
Styrene	0.5
Tetrachloroethene (PCE)	0.5
Toluene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-Trichloroethane	0.5
Trichloroethylene	0.5
Vinyl chloride	0.5
Xylenes (total)	0.5
Bromodichloromethane	0.5
Dibromochloromethane	0.5
Bromoform	0.5
Chloroform	0.5
Bromobenzene	0.5
Bromochloromethane	0.5
Bromomethane	0.5
n-Butylbenzene	0.5
sec-Butylbenzene	1.0
tert-Butylbenzene	0.5
Chloroethane	0.5
Chloromethane	0.5
2-Chlorotoluene	0.5

Table C.1 continued. List of volatile organic compounds (VOCs) analyzed for water samples.

Analyte	Minimum detectable concentrations (MDC) (expressed in µg/L)
4-Chlorotoluene	0.5
1,2-Dibromo-3-chloropropane (DBCP)	0.5
1,2-Dibromoethane (EDB)	0.5
Dibromomethane	0.5
1,3-Dichlorobenzene	0.5
Dichlorodifluoromethane	0.5
1,1-Dichloroethane	0.5
1,3-Dichloropropane	0.5
2,2-Dichloropropane	0.5
1,1-Dichloropropene	0.5
cis-1,3-Dichloropropene	0.5
trans-1,3-Dichloropropene	1.0
Hexachlorobutadiene	0.5
Isopropylbenzene	0.5
p-Isopropyltoluene	0.5
Methyl Tert Butyl Ether (MTBE)	0.5
Naphthalene	0.5
n-Propylbenzene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,2,3-Trichlorobenzene	0.5
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	0.5
1,2,4-Trimethylbenzene	1.0
1,3,5-Trimethylbenzene	0.5