Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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Table of Acronyms

aCi/L - attocuries per liter
ATR - Advanced Test Reactor
BEA - Battelle Energy Alliance, LLC
BLR - Big Lost River
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFA - Central Facilities Area
CFR - Code of Federal Regulations
CITRC - Critical Infrastructure Test Range Complex
DEQ-INL OP - The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program
DOE - U.S. Department of Energy
EBR I & II - Experimental Breeder Reactors I & II
EFS - Experimental Field Station
EIC - electret ionization chamber
EML - Environmental Monitoring Laboratory
EPA - Environmental Protection Agency
ESER - Environmental Surveillance, Education and Research Program
ESP - Environmental Surveillance Program
ESRPA - Eastern Snake River Plain Aquifer
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 third 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 midway through the 3rd quarter 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 previous Idaho Falls HVP 4304 sampler was moved to Craters of the Moon to replace that failing TSP sampler. 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 third 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.

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

Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the third quarter.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. Weighted mean atmospheric tritium was below the minimum detectable concentration (MDC) during the third quarter of 2016. There is one individual sample within the weighted mean that exceeded MDC located at the Experimental Field Station sampling site: 1.28 pCi/m^3 (MDC 1.05 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 third 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 third quarter of 2016. Tritium and Cesium-137 analysis results are presented in **Table 5**.

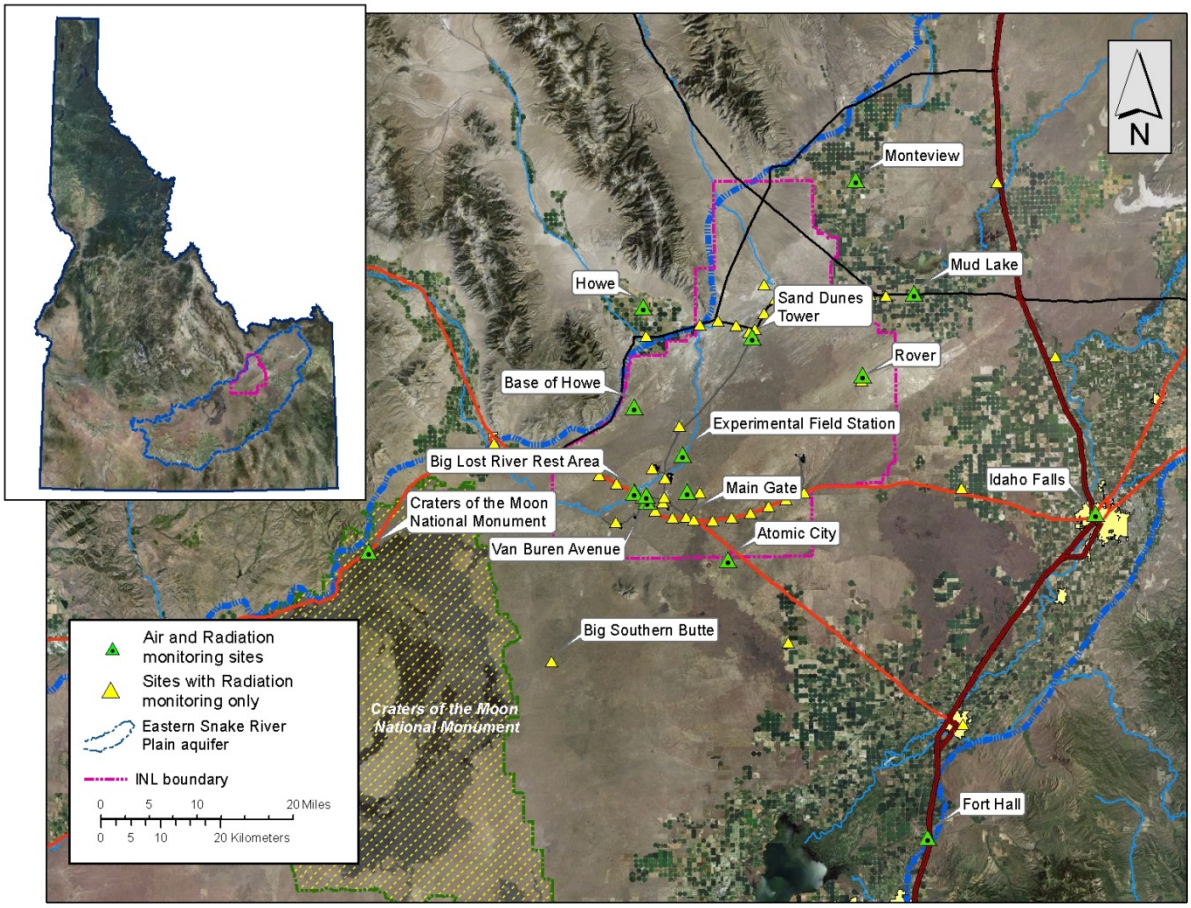

Figure 1. Air and radiation monitoring locations.

Table 1. Sampling locations and sample type

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

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

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

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.7	-	2.6	24.8	-	41.0
Experimental Field Station	0.9	-	2.5	19.3	-	35.3
Sand Dunes Tower	0.3	-	3.2	13.4	-	28.2
Van Buren Avenue	0.6	-	3.2	16.3	-	35.2
Boundary Locations						
Atomic City	0.8	-	2.5	20.2	-	36.5
Howe	0.4	-	4.4	16.6	-	31.0
Monteview	0.6	-	2.2	17.3	-	32.4
Mud Lake	0.9	-	3.2	23.9	-	45.8
Distant Locations						
Craters of the Moon	0.4	-	2.7	20.3	-	38.2
Fort Hall[1]	1.0	-	3.4	14.5	-	30.8
Idaho Falls – HVP 3804	0.8	-	2.1	22.1	-	38.2
Idaho Falls – HVP 4304	0.9	-	1.3	24.7	-	31.8

[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, third 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	110.3	5.8	<MDC[2]	
Experimental Field Station	98.5	5.0	<MDC	
Sand Dunes Tower	70.0	3.6	<MDC	
Van Buren Avenue	79.8	4.3	<MDC	
Boundary Locations				
Atomic City	96.8	4.9	<MDC	
Howe	76.8	4.2	<MDC	
Monteview	96.5	4.9	<MDC	
Mud Lake	117.4	6.0	<MDC	
Distant Locations				
Craters of the Moon	98.7	5.1	<MDC	
Fort Hall[1]	70.1	3.8	<MDC	
Idaho Falls – HVP 3804	102.9	5.2	<MDC	
Idaho Falls – HVP 4304[3]	141.7[3]	7.9[3]	<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).
[3]Idaho Fall –HVP 4304 operated for only the last four weeks of the quarter. The reduced air volume led to increased concentration and 2s, which precludes comparison with the Idaho Falls – HVP 3804 sampler results.

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

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	-0.10	0.46	0.76
Experimental Field Station	0.69	0.46	0.74
Sand Dunes Tower	-0.02	0.42	0.71
Van Buren Avenue	0.16	0.52	0.87
Boundary Locations			
Atomic City	0.02	0.46	0.79
Howe	0.16	0.58	0.99
Mud Lake	0.04	0.61	1.03
Monteview	0.20	0.65	1.08
Distant Locations			
Craters of the Moon	-0.11	0.31	0.54
Fort Hall[1]	-0.02	0.49	0.82
Idaho Falls	0.12	0.55	0.92

[1]Operated by Shoshone-Bannock Tribes.
Note: Concentrations are reported in pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 5. Tritium and Cesium-137 concentrations from precipitation, third quarter, 2016

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	0	110	180	0.2	0.9	1.5
Boundary Locations						
Atomic City	10	110	180	0.6	1.3	2.2
Howe	-60	110	180	0.0	1.2	2.0
Monteview	-30	110	180	-1.2	1.4	2.6
Mud Lake	-40	110	180	0.0	1.5	2.6
Distant Locations						
Idaho Falls	-20	110	180	0.3	2.0	3.5

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 third 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 6**).

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 7** lists the average radiation exposure rates measured by the HPICs for third quarter 2016. **Table 8** lists the EIC monitoring results for third quarter 2016. 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, third quarter, 2016, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	16.0	1.1
Big Lost River Rest Area	15.3	0.7
Main Gate	14.9	1.2
[1]Rover	-	-
Sand Dunes Tower	13.5	0.7
Boundary Locations		
Atomic City	13.2	1.0
[1]Big Southern Butte	15.5	1.3
[1]Howe Met Tower	11.2	0.8
Monteview	13.5	1.1
Mud Lake / Terreton	14.2	0.8
Distant Locations		
Fort Hall	11.9	2.4
Idaho Falls	12.1	2.7

[2]Rover location HPIC electronics had various electronic malfunctions and/or extreme temperature interference and the data was therefore unusable; no data is available for third quarter 2016 at this location.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, third quarter, 2016.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	15.5	1.7
Big Lost River Rest Area	16.7	1.8
Experimental Field Station	14.8	1.1
Main Gate	15.1	3.2
Rover	15.8, 16.8	
Sand Dunes Tower	13.5	3.5
Van Buren Avenue	15.7	2.2
Boundary Locations		
Atomic City	12.7	1.7
Big Southern Butte	14.8, 16.1	
Howe Met Tower	12.4	0.5
Monteview	15.0	2.7
Mud Lake/Terreton	13.1	1.5
Distant Locations		
Craters of the Moon	10.3	0.9
Fort Hall	11.2	3.4
Idaho Falls	9.1	1.2

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

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 third quarter of 2016, 1 up-gradient, 1 boundary, 5 facility, and 14 distant locations were 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, uranium, and americium; and beta emitting

radionuclides technetium-99 and strontium-90, 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 5 facility, 1 boundary, and 8 distant locations. Concentrations observed at facility locations are consistent with historical trends associated with each facility. All other locations with detectable results were 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 all of the locations sampled during this quarter. Concentrations observed for all up-gradient, boundary, facility, and distant locations were consistent with the expected values at each monitoring site. 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 ^{3}H; or 200 pCi/L if ^{137}Cs. Man-made, gamma emitting ^{137}Cs was detected at two facility locations, TAN-2271 and TAN-37A. A recount of both samples confirmed the initial analysis results for each sample location. Both wells are located in an area affected by historic INL waste disposal practices. TAN-2271 is a relatively new well, drilled in 2015, having only been sampled once before by DEQ-INL OP with non-detectable ^{137}Cs results. Monitoring well TAN-37A is located near TAN-2271 and has been sampled by DEQ-INL OP since 2007. TAN-37A has shown detectable concentrations of ^{137}Cs in the past, most recently in April 2015. Results for gross alpha, gross beta, and man-made, gamma emitting ^{137}Cs are shown in **Table 9**.

Three facility locations were sampled for isotopes of uranium with all showing detectable results for ^{234}U, ^{235}U, and ^{238}U (**Table 10**). Analysis results for samples collected from TAN-28, TAN-29, and TAN-37A suggest ^{238}U and ^{234}U at greater than natural background levels. Uranium related to historic waste disposal activities at Test Area North has previously been identified. None of the sample locations were sampled for ^{241}Am this quarter. All TAN facility locations were analyzed for ^{90}Sr and had results above the drinking water MCL of 8 pCi/L (**Table 11**). All samples were collected in areas of known contamination at or near the TAN facility.

Using the standard analytical method, ^{3}H was detected at all TAN facility wells (**Table 12**). The ^{3}H concentrations reported are consistent with historic INL waste disposal influences. 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. All ten sites that were analyzed using the enrichment method were collected during the previous field sample season (2015) and are presented in **Table 13**. A backlog of 96 samples remains.

Samples were also analyzed for metals, common ions, and nutrients with results shown in **Tables 14, 15** and **16**. All results were within expected ranges at each location. TAN facility wells may have elevated concentrations for certain analytes that are consistent with conditions created from in-situ bioremediation (ISB) efforts as part of the clean-up actions for Volatile Organic Compounds (VOCs) in ground water.

Volatile Organic Compounds (VOCs) were sampled at five locations at or near the TAN facility. The VOC samples collected for TAN facility wells TAN-2271 and TAN-2272B were rejected. Both samples had low internal standard responses and failed surrogate spikes. The other three TAN facility wells, including TAN-28, TAN-29, and TAN-37A, reported detectable concentrations for multiple analytes. Results are shown in **Table 17.** The background concentrations for these VOCs should be non-detectable. The results discussed in this section only refer to detectable VOC concentrations; a complete list of analytes is shown in **Appendix C**.

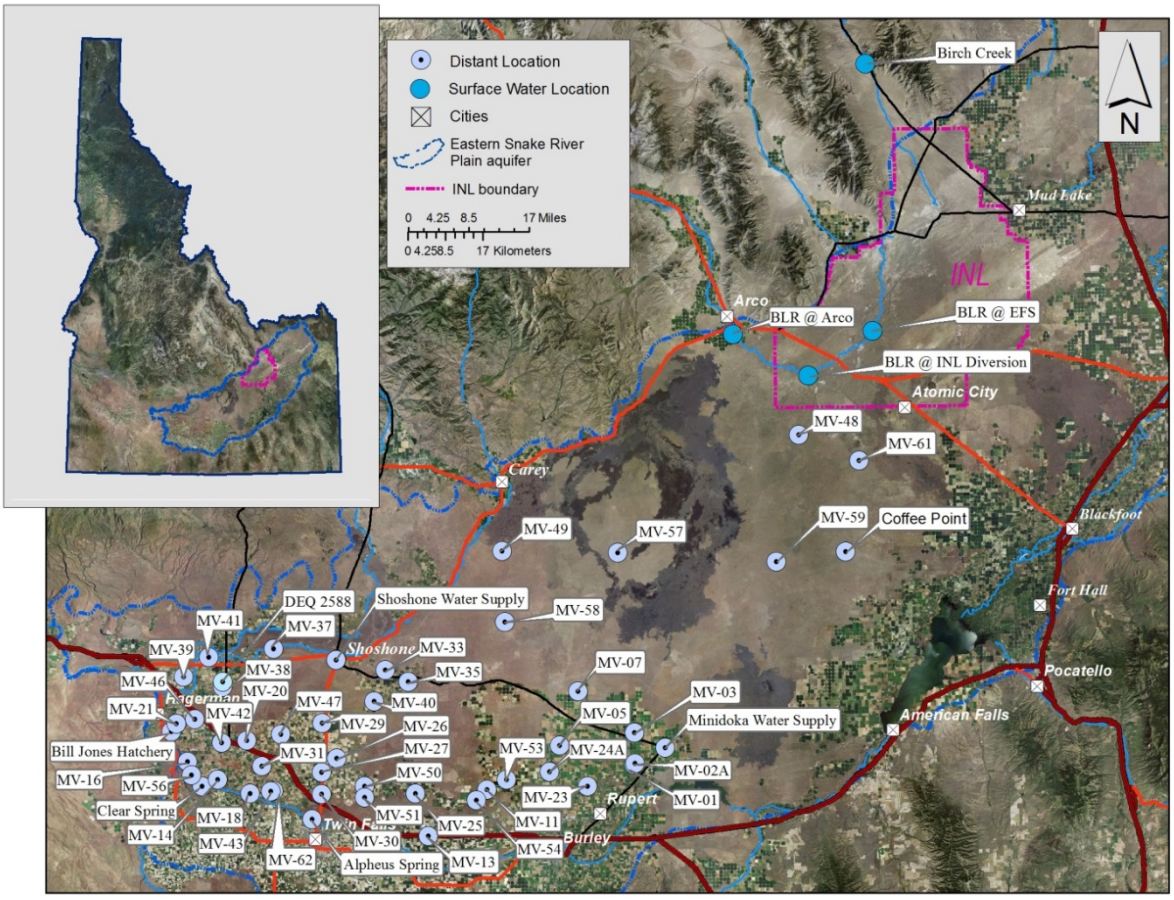

Figure 2. Distant and Surface Water monitoring locations.

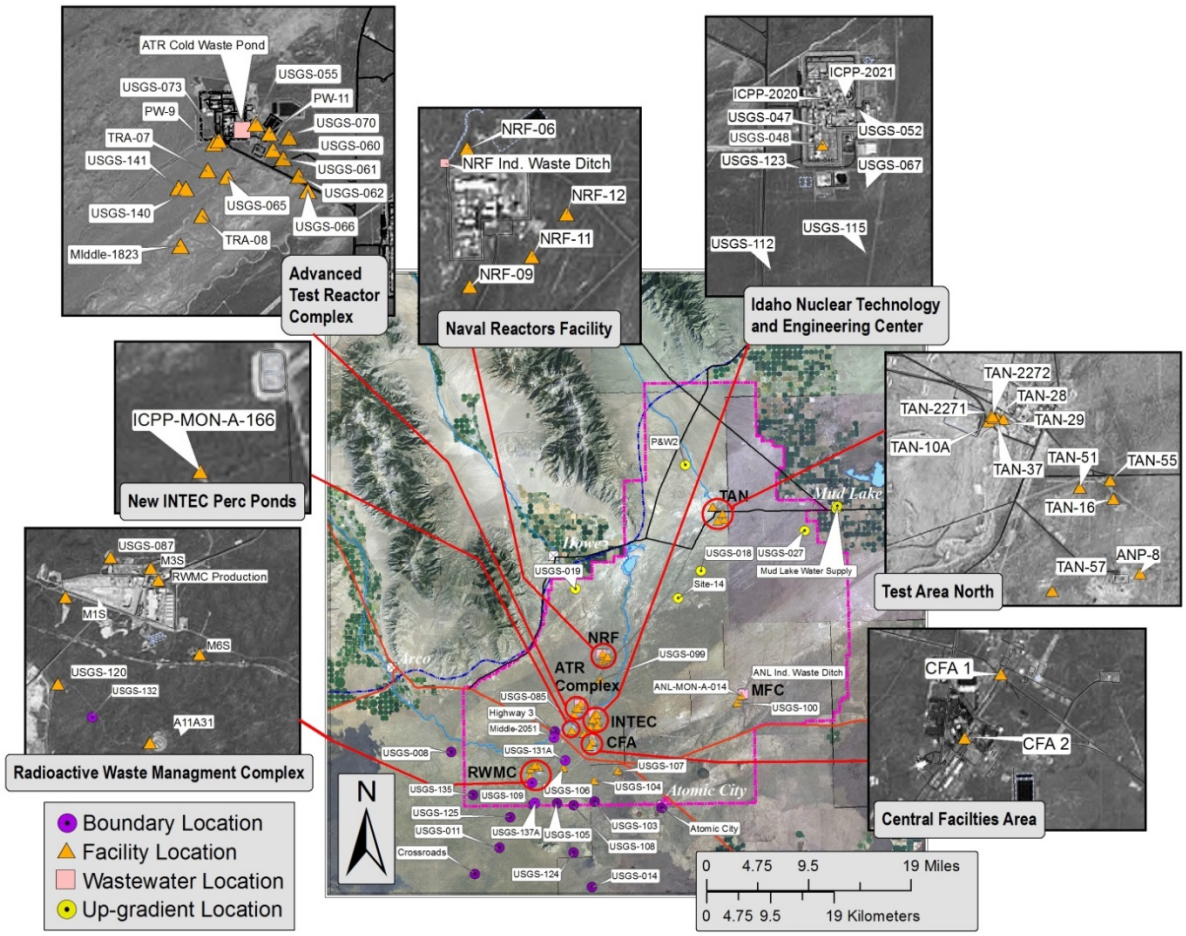

Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

Table 9. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations for water samples, third 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
Up-gradient										
Mud Lake Water Supply	9/1/2016	-0.3	U	0.6	4.6		0.8	-0.8	U	1.2
Facility										
TAN-2271	7/12/2016	15.0		5.9	1994		24	2.5		1.5
TAN-2272B	7/12/2016	12.1		5.3	814.4		15.5	1.1	U	1.7
TAN-28	7/11/2016	8.1		3.0	365.2		6.6	0.2	U	1.2
TAN-29	7/11/2016	4.3		2.1	42.7		2.4	-1.1	U	1.5
TAN-37A	7/11/2016	7.8		3.1	932.9		11.7	3.6		2.0
Boundary										
Highway 3	7/7/2016	1.6		0.9	1.8		0.8	0.1	U	1.4
Distant										
Alpheus Spring	8/25/2016	1.3	U	1.1	6.8		1.0	0.4	U	1.5
Bill Jones Hatchery	8/25/2016	2.2		1.0	3.7		0.9	0.4	U	1.5
Clear Spring	8/25/2016	0.6	U	1.0	5.2		1.0	-1.2	U	1.2
Minidoka Water Supply	8/25/2016	0.6	U	0.9	2.6		0.9	1.0	U	1.6
MV-03	7/18/2016	-1.5	U	1.1	4.0		0.9	-0.1	U	1.5
MV-05	7/18/2016	1.7	U	1.4	6.5		1.1	1.2	U	1.8
MV-07	7/18/2016	1.3		0.9	3.1		0.9	0.3	U	1.5
MV-13	7/18/2016	2.6		1.4	6.5		1.1	0.0	U	1.3
MV-27	7/18/2016	2.6		1.4	7.8		1.2	-0.1	U	1.1
DEQ 2588	8/31/2016	2.8		1.2	3.5		1.0	0.5	U	1.6
MV-38	8/31/2016	1.8		0.9	2.7		0.8	-0.2	U	1.3
MV-53	7/18/2016	3.8		1.8	6.3		1.5	-0.2	U	1.2
MV-56	7/19/2016	-1.2	U	1.1	4.5		0.9	0.3	U	1.7
Shoshone Water Supply	8/25/2016	1.8		1.0	2.6		0.8	2.1	U	1.4

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations with associated uncertainties (±2 SD) expressed in pCi/L.

Table 10. Reported concentrations of uranium isotopes in water samples, third 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										
TAN-28	7/11/2016	8.7		1.5	0.42		0.15	1.56		0.36
TAN-29	7/11/2016	6.0		1.1	0.126		0.081	1.18		0.29
TAN-37A	7/11/2016	4.76		0.89	0.22		0.11	0.82		0.23

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations with associated uncertainties (±2 SD) expressed in pCi/L.

Table 11. Reported concentrations of strontium-90 in water samples, third quarter, 2016.

Sample Location	Sample Date	Strontium-90		
		Concentration[1,2]		±2 SD
Facility				
TAN-2271	7/12/2016	770		180
TAN-2272B	7/12/2016	380		89
TAN-28	7/11/2016	134		32
TAN-29	7/11/2016	14.8		3.6
TAN-37A	7/11/2016	369		87

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations with associated uncertainties (±2 SD) expressed in pCi/L.

Table 12. Tritium concentrations for water samples, third quarter, 2016.

Sample Location	Sample Date	Tritium		
		Concentration[1,2]		±2 SD
Up-gradient				
Mud Lake Water Supply	9/1/2016	30	U	110
Facility				
TAN-2271	7/12/2016	580		110
TAN-2272B	7/12/2016	610		110
TAN-28	7/11/2016	2170		160
TAN-29	7/11/2016	1470		140
TAN-37A	7/11/2016	900		120
Boundary				
Highway 3	7/7/2016	30	U	90
Distant				
Alpheus Spring	8/25/2016	70	U	110
Bill Jones Hatchery	8/25/2016	-20	U	110
Clear Spring	8/25/2016	-20	U	110
Minidoka Water Supply	8/25/2016	-50	U	110
MV-03	7/18/2016	60	U	80
MV-05	7/18/2016	-20	U	80
MV-07	7/18/2016	-10	U	80
MV-13	7/18/2016	150	U	120
MV-27	7/18/2016	10	U	90
DEQ 2588	8/31/2016	10	U	110
MV-38	8/31/2016	90	U	110
MV-53	7/18/2016	10	U	80
MV-56	7/19/2016	0	U	80
Shoshone Water Supply	8/25/2016	10	U	110

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

[2]Concentrations with associated uncertainties (±2 SD) expressed in pCi/L.

Table 13. Enriched tritium concentrations for water samples from previous sampling quarters.

Sample Location	Sample Date	Enriched Tritium		
		Concentration[1,2]		±2 SD
Up-gradient				
Mud Lake Water Supply	7/16/2015	0	U	7
Facility				
NRF-12	5/12/2015	20		6
Boundary				
USGS-014	10/21/2015	3	UJ	7
Distant				
Alpheus Spring	7/13/2015	15	UJ	13
Alpheus Spring	11/5/2015	13	J	7
Clear Spring	7/13/2015	3	U	7
Clear Spring	11/5/2015	2	UJ	7
MV-31	7/13/2015	6	UJ	9
MV-51	6/29/2015	15		6
MV-62	7/13/2015	17		6

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

[2]Concentrations with associated uncertainties (±2 SD) expressed in pCi/L.

Table 14. Reported metals concentrations in water samples, third quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]															
		Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Up-gradient																	
Mud Lake Water Supply	9/1/2016	8.9		19		<1.0	U	<10	U	<1.0	U	35		<2.0	U	<10	U
Facility																	
TAN-2271	7/12/2016	<5.0	U	1600		10		11000		<2.5	U	3800		<5.0	U	<25	U
TAN-2272B	7/12/2016	<6.2	U	1200		20		11000		<3.1	U	1900		<6.2	U	<31	U
TAN-28	7/11/2016	<2.5	U	360		<1.2	U	10		<1.2	U	310		<2.5	U	23	
TAN-29	7/11/2016	<2.0	U	260		1.0		<10	U	<1.0	U	34		<2.0	U	16	
TAN-37A	7/11/2016	3.3		490		<1.0	U	3000		<1.0	U	1200		<2.0	U	<10	U
Boundary																	
Highway 3	7/7/2016	<2.0	U	54		2.2		<10	U	<1.0	U	<1.0	U	<2.0	U	78	
Distant																	
Alpheus Spring	8/25/2016	2.6		82		1.7		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
Bill Jones Hatchery	8/25/2016	2.2		22		3.6		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
Clear Spring	8/25/2016	2.4		37		2.7		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
Minidoka Water Supply	8/25/2016	2.0		35		2.1		<10	U	<1.0	U	<1.0	U	<2.0	U	16	
MV-03	7/18/2016	2.2		22		2.2		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-05	7/18/2016	3.0		67		1.9		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-07	7/18/2016	2.1		22		2.7		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-13	7/18/2016	3.2		92		1.0		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-27	7/18/2016	2.2		63		2.0		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
DEQ 2588	8/31/2016	<2.0	U	34		1.9		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-38	8/31/2016	<2.0	U	31		2.5		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
MV-53	7/18/2016	2.7		110		1.6		<10	U	<1.0	U	<1.0	U	<2.0	U	87	
MV-56	7/19/2016	2.3		26		2.7		<10	U	<1.0	U	<1.0	U	<2.0	U	<10	U
Shoshone Water Supply	8/25/2016	<2.0	U	40		2.4		<10	U	<1.0	U	<1.0	U	<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 15. Reported common ion concentrations in water samples, third quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]																	
		Calcium		Magnesium		Sodium		Potassium		Fluoride		Chloride		Sulfate		Alkalinity[3]		Iodide	
Up-gradient																			
Mud Lake Water Supply*	9/1/2016	8.9		2.8		30		4.8		0.62		5.01		8.42		91		NR	
Facility																			
TAN-2271*	7/12/2016	170		110		190		11		2.49	J	124		2.14		912		NR	
TAN-2272B*	7/12/2016	110		94		360		7.9		5.16		126		1.85		1170		NR	
TAN-28*	7/11/2016	100		32		78		6.6		<0.2	U	103		39.5		366		NR	
TAN-29*	7/11/2016	71		20		52		5.0		<0.2	U	91.1		40.1		226		NR	
TAN-37A*	7/11/2016	88		49		110		11		<0.2	U	116		62.0		511		NR	
Boundary																			
Highway 3*	7/7/2016	45		12		6.2		2.6		0.233		6.44		22.0		148		NR	
Distant																			
Alpheus Spring*	8/25/2016	57		20		34		6.5		0.423		40.8		56.7		182		NR	
Bill Jones Hatchery*	8/25/2016	33		17		17		3.6		0.463		12.5		28.6		141		NR	
Clear Spring*	8/25/2016	47		20		26		4.2		0.582		33.7		48.1		150		NR	
Minidoka Water Supply*	8/25/2016	47		16		20		3.5		0.650		32.1		42.9		140		NR	
MV-03*	7/18/2016	36		14		19		3.2		0.696		20.3		29.5		132		<0.05	U
MV-05*	7/18/2016	56		24		48		5.6		0.483		59.5		72.7		180		<0.05	U
MV-07*	7/18/2016	33		14		17		3.4		0.608		13.7		31.6		125		<0.05	U
MV-13*	7/18/2016	53		19		35		6.5		0.372		33.1		53.6		184		NR	
MV-27*	7/18/2016	58		23		37		5.3		0.438		51.6		66.1		178		<0.05	U
DEQ 2588*	8/31/2016	43		15		16		3.1		0.320		13.3		24.2		158		NR	
MV-38*	8/31/2016	40		14		15		3.0		0.327		10.9		21.8		151		NR	
MV-53*	7/18/2016	67		28		52		7.0		0.397		66.4		77.8		220		NR	
MV-56*	7/19/2016	37		17		21		3.8		0.580		23.5		38.0		137		<0.05	U
Shoshone Water Supply*	8/25/2016	43		15		14		3.0		0.298		7.16		19.2		169		NR	

[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 16. Reported nutrient concentrations in water samples, third quarter, 2016.

Sample Location	Sample Date	Concentration[1,2]			
		Nitrite + Nitrate		Phosphorus	
Up-gradient					
Mud Lake Water Supply	9/1/2016	<0.01	U	0.042	
Facility					
TAN-2271	7/12/2016	<0.01	U	0.63	
TAN-2272B	7/12/2016	<0.01	U	1.6	
TAN-28	7/11/2016	4.2		0.076	
TAN-29	7/11/2016	1.7		0.04	
TAN-37A	7/11/2016	<0.01	U	0.66	
Boundary					
Highway 3	7/7/2016	0.48		0.022	
Distant					
Alpheus Spring	8/25/2016	2.0		0.025	
Bill Jones Hatchery	8/25/2016	1.5		0.021	
Clear Spring	8/25/2016	2.0		0.029	
Minidoka Water Supply	8/25/2016	1.1		0.016	
MV-03	7/18/2016	0.96		0.014	
MV-05	7/18/2016	3.1		0.019	
MV-07	7/18/2016	0.51		0.013	
MV-13	7/18/2016	1.9		0.024	
MV-27	7/18/2016	2.3		0.020	
DEQ 2588	8/31/2016	1.5		0.038	
MV-38	8/31/2016	1.2		0.035	
MV-53	7/18/2016	5.3		0.022	
MV-56	7/19/2016	1.4		0.021	
Shoshone Water Supply	8/25/2016	1.2		0.034	

[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.

Table 17. Reported VOC concentrations in water samples, third quarter, 2016.

Sample Location	Sample Date	Concentrations[1,2]						
		1,1-Dicholoroethene	Carbon tetrachloride	Cis-1,2-Dichloroethene	Trans-1,2-Dichlorethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl Chloride
Highway 3	7/7/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TAN-2271	7/12/2016	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R
TAN-2272B	7/12/2016	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R	<0.5R
TAN-28	7/11/2016	1.09	<0.5	120	56.1	10.7	1070	2.9J
TAN-29	7/11/2016	0.87	<0.5	80.1	17.6	16.5	716	1.95J
TAN-37A	7/11/2016	<0.5	<0.5	9.62	117	<0.5	37	6.53J

[1]Data qualifiers: J = estimate, R = rejected, "<" = less than detection limit.
[2]Concentrations expressed in µg/L.

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 during the third 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 18**. ^{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 18. Gamma spectroscopy analysis data for milk samples, third quarter, 2016.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Riverside	07/03/2016	1321	94	<MDC
	08/08/2016	1871	131	<MDC
	09/19/2016	1833	116	<MDC
Gooding/Glanbia	07/21/2016	1263	108	<MDC
	08/31/2016	1317	109	<MDC
	09/14/2016	1290	108	<MDC
Verification Samples[2]				
Dietrich	07/05/2016	1324	93	<MDC
Howe	07/05/2016	1410	114	<MDC
Rupert	08/02/2016	1451	116	<MDC
Terreton	08/02/2016	1519	116	<MDC
Idaho Falls	09/06/2016	1316	94	<MDC
Dietrich	09/06/2016	1304	109	<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.

Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation capable of identifying and measuring *in-situ* concentrations of gamma-emitting radionuclides in soil. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons. Eighteen soil samples were collected and prepared in the field at nine locations (**Figure 4**) during the third calendar

quarter of 2016. ^{137}Cs was the only man made gamma emitting radionuclide detected. Analysis results for ^{137}Cs concentrations for physical soil samples are shown in **Table19.**

Table 19. Gamma spectroscopic analysis results (^{137}Cs) for physical soil sampling, third quarter, 2016.

Location	Sample Type[1]	Sample Depth (cm)	Date Collected	Concentration[2]	±2 SD	MDC
Atomic City	Puck	0 to 5	7/11/2016	0.35	0.07	0.09
Atomic City	Puck	5 to 10	7/11/2016	0.04 U[3]	0.03	0.08
Butte City	Puck	0 to 5	7/11/2016	0.53	0.08	0.09
Butte City	Puck	5 to 10	7/11/2016	0.07 U[3]	0.04	0.09
Carey	Puck	0 to 5	7/11/2016	0.49	0.08	0.10
Carey	Puck	5 to 10	7/11/2016	0.09	0.04	0.08
Frenchman's Cabin	Puck	0 to 5	7/11/2016	0.16	0.04	0.08
Frenchman's Cabin	Puck	5 to 10	7/11/2016	0.04 U[3]	0.02	0.05
Howe	Puck	0 to 5	7/12/2016	0.31	0.06	0.09
Howe	Puck	5 to 10	7/12/2016	0.20	0.05	0.08
Monteview	Puck	0 to 5	7/12/2016	0.30	0.06	0.09
Monteview	Puck	5 to 10	7/12/2016	0.16	0.04	0.07
Mud Lake	Puck	0 to 5	7/12/2016	0.24	0.04	0.09
Mud Lake	Puck	5 to 10	7/12/2016	0.08	0.03	0.07
Reno Ranch	Puck	0 to 5	7/12/2016	0.48	0.07	0.08
Reno Ranch	Puck	5 to 10	7/12/2016	0.14	0.04	0.08
St. Anthony	Puck	0 to 5	7/12/2016	0.50	0.08	0.11
St. Anthony	Puck	5 to 10	7/12/2016	0.38	0.07	0.11

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

The average Cesium-137 value was 0.25 picocuries per gram (pCi/g) with a minimum value of 0.04 pCi/g and a maximum of 0.53 pCi/g, well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g. Based upon terrestrial radiological measurements of soil and milk, there were no discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

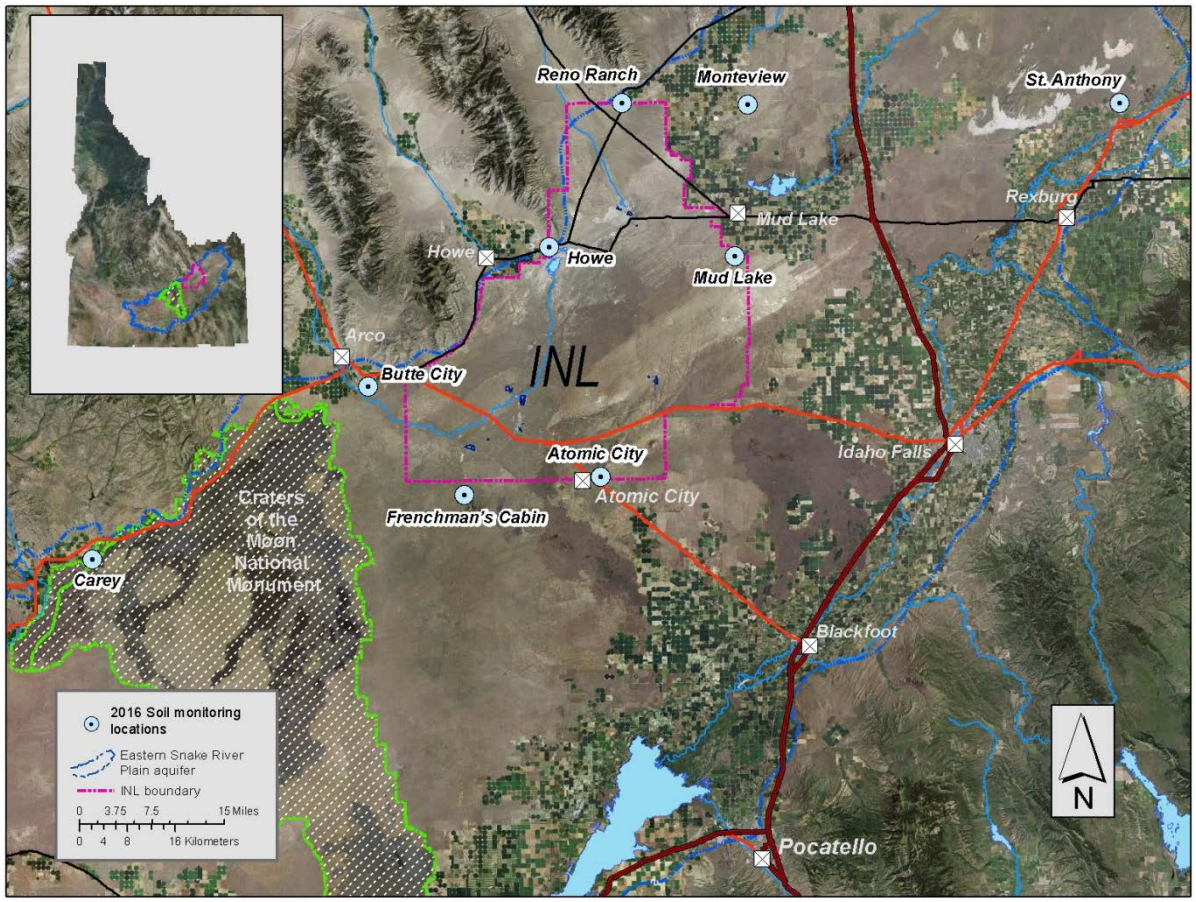

Figure 4. Physical soil monitoring locations.

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 third 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 third quarter of 2016, the DEQ-INL OP submitted 83 QC samples for various radiological and non-radiological analyses (**Table 20**).

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 third quarter of 2016 are presented in **Table 21**.

Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 22**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 23**. Blank analyses results for radiological and non-radiological analytes in ground and surface water are presented in **Table 24**, **Table 25**, **Table 26**, and **Table 27**.

No anomalies were observed from the assessment of field blank samples as measured by the analytical laboratories used by DEQ-INL OP for the third quarter of 2016.

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.

Duplicate results for ground and surface water are presented in **Table 28** for radiological analyses, and **Table 29**, **Table 30**, and **Table 31** for non-radiological analyses. Duplicate results for radiological analyses of physical soil analyses are presented in **Table 32.**

All field duplicate samples passed comparison criteria during the third quarter of 2016.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added 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.

During third quarter 2016, several spiked samples were created using de-ionized water and submitted to analytical laboratories for analyses. These non-radiological constituents were used to assess ground water analyte recovery rates and the results are presented in **Table 33, Table 34,** and **Table 35**.

Spiked samples for vinyl chloride exceeded recovery limits (**Table 35**). All results for vinyl chloride that were analyzed with the spiked samples, and which exceeded the detection limit were flagged with a (J) and qualified as an estimate.

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 the average triplicate measurement has a percent recovery of 100±25% when compared to the known irradiated quantity. The irradiation results for third quarter 2016 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

No issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples (other than the vinyl chloride spike discussed above) were observed during the third 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 third 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 third quarter of 2016 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 20**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the third quarter of 2016 the radioiodine pump was replaced at the Sand Dunes sampling station. The TSP blower was replaced at Idaho Falls, Craters of the Moon, Experimental Field Station, and twice at Rest Area. The samplers at Idaho Falls and Experimental Field Station were out of service for a very short period of time. Both samplers were able to accumulate enough sample volume for a valid sample during the week in which the blower failed. Service reliability for air sampling equipment for the third quarter of 2016 is summarized in **Table 37**.

Conclusion

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

Table 20. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, third 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	140	13	0	0	4	ISU-EML
		Gross beta	140	13	0	0	4	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	39	3	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	21	1	3	0	0	ISU-EML
		Gross beta	21	1	3	0	0	ISU-EML
		Gamma emitters	21	1	3	0	0	ISU-EML
		Tritium	21	1	3	0	0	ISU-EML
		Enriched tritium	10	0	0	0	0	ISU-EML
		Technetium-99	0	0	0	0	0	ISU-EML
		Radiochemical	8	0	4	0	0	ISU Sub
		Metals	21	1	3	1	0	IBL
		Common Ions	21	1	3	1	0	IBL
		Nutrients	21	1	3	1	0	IBL
		Volatile Organics	6	2	2	1	2	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	12	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	18	0	4	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	55	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	12	NA	NA	NA	0	DEQ-INL OP
Total Analyses			**624**	**39**	**31**	**13**	**10**	
Total of QC Analyses (blanks, duplicates, and spikes)			**83**					
Percentage of QC analyses of total Test analyses[3]			**13.3%**					
Percentage of usable data[4]			**98.4%**					

[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 21. Blank analysis results for gross alpha and beta in particulate air (TSP), third quarter, 2016.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
06/30/16	07/07/16	2026	0.0	0.1	0.0	0.5
07/07/16	07/14/16	2026	0.1	0.1	0.2	0.5
07/14/16	07/21/16	2026	0.1	0.1	0.1	0.5
07/21/16	07/28/16	2026	0.1	0.1	0.0	0.5
07/28/16	08/04/16	2026	0.0	0.1	0.1	0.4
08/04/16	08/11/16	2026	0.0	0.1	-0.6	0.4
08/11/16	08/18/16	2026	0.1	0.1	-0.2	0.5
08/18/16	08/25/16	2026	0.0	0.1	0.3	0.5
08/25/16	09/01/16	2026	-0.1	0.1	-0.4	0.5
09/01/16	09/08/16	2026	0.0	0.1	-0.3	0.5
09/08/16	09/15/16	2026	0.0	0.1	0.7	0.5
09/15/16	09/22/16	2026	-0.1	0.1	0.0	0.4
09/22/16	09/29/16	2026	-0.1	0.1	0.1	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 22. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, third 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
10/13/16	0	1	2	-15	41	74	-2	6	10

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
10/13/16	-1	2	4	-2	2	4

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 23. Blank analysis results for tritium in water vapor from air samples, third quarter, 2016.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP163ZTR01	10/03/16	10/17/16	10/25/16	0.00	0.08	0.14
OP163ZTR02	10/03/16	10/19/16	10/25/16	0.04	0.08	0.14
OP163ZTR03	10/03/16	10/19/16	10/25/16	0.05	0.08	0.14

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

Table 24. Radiological blank analysis results in groundwater and/or surface water, third quarter, 2016.

Sample Number	Sample Date	Concentration[1]	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
161W512	9/01/2016	0.1	0.2	0.4	Yes
Gross Beta					
161W512	9/01/2016	-0.4	0.6	1.0	Yes
Cesium-137					
161W512	9/01/2016	0.7	1.6	2.7	Yes
Tritium					
161W514	9/01/2016	90	110	180	Yes

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

Table 25. Blank analysis results (µg/L) for metals in groundwater and/or surface water, third quarter, 2016.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
161W516	9/01/2016	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	<10

Table 26. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, third quarter, 2016.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
161W517,516,515	9/01/2016	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	<1.0	<0.01	<0.005

Table 27. Blank analysis results (µg/L) for VOCs in groundwater and/or surface water, third quarter, 2016.

Sample Number	Sample Date	1,1-Dichloroethene	Carbon tetrachloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
161W381	7/07/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
161W295	7/12/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 28. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, third 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]
Gross Alpha									
TAN-29	161W422	4.3	2.1	161W430	5.1	1.9	0.8	4.2	Yes
Highway 3	161W382	1.6	0.9	161W388	1.9	0.9	0.3	1.9	Yes
MV-53	161W500	3.8	1.8	161W494	1.6	1.9	2.2	3.9	Yes
Gross Beta									
TAN-29	161W422	42.7	2.4	161W430	42.9	2.4	0.2	5.1	Yes
Highway 3	161W382	1.8	0.8	161W388	2.4	0.9	0.6	1.8	Yes
MV-53	161W500	6.3	1.5	161W494	7.4	1.6	1.1	3.3	Yes
Gamma Spectroscopy Cesium-137									
TAN-29	161W422	-1.1	1.5	161W430	0.8	1.5	1.9	3.2	Yes
Highway 3	161W382	0.1	1.4	161W388	-0.1	1.5	0.2	3.1	Yes
MV-53	161W500	-0.2	1.2	161W494	0.4	1.6	0.6	3.0	Yes
Tritium									
TAN-29	161W424	1470	140	161W432	1500	140	30	297	Yes
Highway 3	161W383	30	90	161W389	70	90	40	191	Yes
MV-53	161W502	10	80	161W496	10	90	0	181	Yes
Strontium-90									
TAN-29	161W423	14.8	3.6	161W431	16.0	3.9	1.2	8.0	Yes
Uranium-234									
TAN-29	161W425	6.0	1.1	161W433	5.9	1.1	0.1	2.33	Yes
Uranium-235									
TAN-29	161W425	0.126	0.081	161W433	0.22	0.11	0.10	0.20	Yes
Uranium-238									
TAN-29	161W425	1.18	0.29	161W433	1.28	0.30	0.10	0.63	Yes

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

Table 29. Duplicate results for metals (µg/L) in groundwater, third quarter, 2016.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
TAN-29 (dissolved)	161W427	7/11/2016	<2.0	260	1.0	<10	<1.0	34	<2.0	16
TAN-29 (dissolved)	161W435	7/11/2016	<2.0	260	1.2	<10	<1.0	34	<2.0	16
RPD			**0**	**0**	**-18**	**0**	**0**	**0**	**0**	**0**
Highway 3 (dissolved)	161W385	7/7/2016	<2.0	54	2.2	<10	<1.0	<1.0	<2.0	78
Highway 3 (dissolved)	161W391	7/7/2016	<2.0	54	2.2	<10	<1.0	<1.0	<2.0	80
RPD			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-3**
MV-53 (dissolved)	161W504	7/18/2016	2.7	110	1.6	<10	<1.0	<1.0	<2.0	87
MV-44 (dissolved)	161W498	7/18/2016	2.7	100	1.7	<10	<1.0	<1.0	<2.0	90
RPD			**0**	**10**	**-6**	**0**	**0**	**0**	**0**	**-3**

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

Table 30. Duplicate results for common ions and nutrients (mg/L) in groundwater, third quarter, 2016.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
TAN-29*	161W428,427,426	7/11/2016	71	20	52	5	0.200	91.1	40.1	226	1.7	0.04
TAN-29*	161W436,435,434	7/11/2016	71	20	51	5	0.201	93.8	40.3	228	1.7	0.04
RPD			**0**	**0**	**2**	**0**	**-1**	**-3**	**-1**	**-1**	**0**	**0**
Highway 3*	161W386,385,384	7/7/2016	45	12	6.2	2.6	0.233	6.44	22	148	0.48	0.022
Highway 3*	161W392,391,390	7/7/2016	45	12	6.0	2.5	0.218	6.45	22	147	0.48	0.023
RPD			**0**	**0**	**3**	**4**	**7**	**0**	**0**	**1**	**0**	**-4**
MV-53*	161W505,504,503	7/18/2016	67	28	52	7	0.397	66.4	77.8	220	5.3	0.022
MV-44*	161W499,498,497	7/18/2016	68	28	52	7	0.400	66.1	77.7	220	5.3	0.020
RPD			**-1**	**0**	**0**	**0**	**-1**	**1**	**0**	**0**	**0**	**10**

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

* = samples are filtered for calcium, magnesium, sodium, and potassium.

Table 31. Duplicate results for VOCs (µg/L) in groundwater, third quarter, 2016.

Sample Location	Sample Date	Sample Number	Concentrations						
			1,1-Dichloroethene	Carbon tetrachloride	Cis-1,2-Dichloroethene	Trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
Highway 3	161W387	7/7/2016	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Highway 3	161W393	7/7/2016	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RPD			**0**	**0**	**0**	**0**	**0**	**0**	**0**
TAN-29	161W429	7/11/2016	0.87	<5.0	80.1	17.6	16.5	716	1.95
TAN-29	161W437	7/11/2016	0.80	<5.0	83.0	17.0	16.2	698	2.08
RPD			**8**	**0**	**-4**	**4**	**2**	**3**	**-7**

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

Table 32. Duplicate analyses of gamma emitting radionuclides in soil, third quarter, 2016.

Sample Location	Sample Date	Original Result Cs-137 (pCi/g)	QA Result Cs-137 (pCi/g)	Cs-137 RPD (%)	Cs-137 less than 3 sigma test	Cs-137 meets either criterion?
Atomic City 0-5cm	07/11/16	0.35 ± 0.07	0.27 ± 0.06	25.8	In Spec	Yes
Atomic City 5-10cm	07/11/16	0.04 ± 0.03	0.03 ± 0.03	NA[1]	In Spec	Yes
Mud Lake 0-5cm	07/12/16	0.24 ± 0.04	0.35 ± 0.06	37.3	In Spec	Yes
Mud Lake 5-10cm	07/12/16	0.08 ± 0.03	0.10 ± 0.04	22.2	In Spec	Yes

Note: Concentrations are expressed in pCi/g with associated uncertainty (± 2 SD).

[1] RPD not applicable: both results are < MDC.

Table 33. De-ionized water spike results (in µg/L) and percent recovery for metals in groundwater and/or surface water, third quarter, 2016.

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
161W397	7/11/2016	76.4	82.0	**107**	13.8	14	**101**	7.11	7.50	**106**	7.63	8.70	**114**	40.4	33.0	**82**

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

Table 34. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, third quarter, 2016.

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
161W398,397,396	7/11/2016	23.7	23.0	**97**	6.01	6.00	**99**	12.3	12.0	**98**	2.47	2.50	**101**	1.27	1.39	**109**

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

Table 34. continued. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, third quarter, 2016.

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as $CaCO_3$			Total Nitrogen			Total Phosphorus		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
161W398,397,396	7/11/2016	42.8	41.7	**97**	13.6	13.0	**96**	75.8	77.0	**102**	2.31	2.30	**100**	0.0156	0.0150	**96**

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

Table 35. De-ionized water spike results (in µg/L) and percent recovery for VOCs in groundwater and/or surface water, third quarter, 2016.

Spike Sample Number	Sample Date	Styrene			Tetrachloroethylene			Trichloroethylene			Carbon Tetrachloride			Vinyl Chloride		
		Spike	Result	%R[1]	Spike	Result	%R[1]	Spike	Result	%R[1]	Spike	Result	%R[1]	Spike	Result	%R[1]
161W399	7/11/2016	5.28	4.35	**82**	4.48	4.35	**97**	5.04	5.47	**109**	3.53	3.64	**103**	5.40	7.67	**142**

Table 36. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2016.

Electret #	Exposure Received		Net Measured Exposure[1]		%R
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)	
SHY909	38.10	1.91	36.3	1.41	95.3%
SHY914	38.10	1.91	33.5	1.41	87.9%
SHY900	38.10	1.91	33.5	1.41	87.9%
				Triplicate AVG:	**90.4%**
SHY859	30.20	1.51	28.2	1.41	93.4%
SHY850	30.20	1.51	28.2	1.41	93.2%
SHY863	30.20	1.51	28.0	1.42	92.4%
				Triplicate AVG:	**93.0%**
SHY867	19.90	1.00	20.4	1.42	102.7%
SHY881	19.90	1.00	19.3	1.41	97.2%
SHY885	19.90	1.00	18.1	1.41	91.2%
				Triplicate AVG:	**97.0%**

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), third quarter, 2016.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	85%	100%	100%	100%
Experimental Field Station	100%	100%	100%	NC[1]
Sand Dunes Tower	100%	92%	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	92%	100%	100%	NC[1]
Idaho Falls	100%	100%	100%	100%

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

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

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, third quarter, 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	06/30/16	07/07/16	1.4	0.3	34.6	1.3
	07/07/16	07/14/16	1.1	0.2	24.8	1.1
	07/14/16	07/21/16	1.5	0.3	32.7	1.3
	07/21/16	07/28/16	R[1]	R[1]	R[1]	R[1]
	07/28/16	08/04/16	R[1]	R[1]	R[1]	R[1]
	08/04/16	08/11/16	1.6	0.3	36.2	1.3
	08/11/16	08/18/16	1.7	0.3	41.0	1.4
	08/18/16	08/25/16	2.6	0.4	31.9	1.3
	08/25/16	09/01/16	1.5	0.3	39.9	1.5
	09/01/16	09/08/16	1.2	0.3	33.2	1.3
	09/08/16	09/15/16	1.0	0.3	29.1	1.2
	09/15/16	09/22/16	0.7	0.2	29.9	1.2
	09/22/16	09/29/16	1.0	0.3	32.1	1.2
Experimental Field Station	06/30/16	07/07/16	1.0	0.2	21.9	1.0
	07/07/16	07/14/16	1.1	0.2	19.3	1.1
	07/14/16	07/21/16	0.9	0.2	26.7	1.2
	07/21/16	07/28/16	1.8	0.3	29.7	1.3
	07/28/16	08/04/16	2.5	0.4	29.6	1.3
	08/04/16	08/11/16	1.5	0.3	33.1	1.4
	08/11/16	08/18/16	2.0	0.3	35.3	1.3
	08/18/16	08/25/16	2.3	0.4	24.1	1.2
	08/25/16	09/01/16	1.8	0.3	28.9	1.2
	09/01/16	09/08/16	1.3	0.3	23.7	1.1
	09/08/16	09/15/16	1.3	0.3	21.3	1.1
	09/15/16	09/22/16	1.3	0.3	24.3	1.3
	09/22/16	09/29/16	1.0	0.3	26.7	1.2
Sand Dunes Tower	06/30/16	07/07/16	0.8	0.2	20.5	1.0
	07/07/16	07/14/16	0.6	0.2	13.4	0.9
	07/14/16	07/21/16	0.7	0.2	18.2	1.0
	07/21/16	07/28/16	0.9	0.2	19.9	1.0
	07/28/16	08/04/16	3.2	0.4	26.5	1.3
	08/04/16	08/11/16	1.0	0.2	25.0	1.1
	08/11/16	08/18/16	1.4	0.3	28.2	1.1
	08/18/16	08/25/16	1.3	0.3	21.0	1.0
	08/25/16	09/01/16	1.1	0.2	24.5	1.1
	09/01/16	09/08/16	0.9	0.2	18.4	1.0
	09/08/16	09/15/16	0.6	0.2	16.7	0.9
	09/15/16	09/22/16	0.6	0.2	20.8	1.0
	09/22/16	09/29/16	0.3	0.2	17.0	0.9

[1]R – Results rejected due to insufficient sample volume caused by equipment failure.

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

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	06/30/16	07/07/16	0.9	0.2	23.1	1.1
	07/07/16	07/14/16	0.8	0.2	16.3	1.0
	07/14/16	07/21/16	1.1	0.2	23.5	1.1
	07/21/16	07/28/16	1.2	0.3	26.3	1.2
	07/28/16	08/04/16	3.2	0.4	28.9	1.2
	08/04/16	08/11/16	1.3	0.3	28.9	1.2
	08/11/16	08/18/16	1.6	0.3	35.2	1.3
	08/18/16	08/25/16	1.7	0.3	24.3	1.1
	08/25/16	09/01/16	1.3	0.3	27.7	1.2
	09/01/16	09/08/16	0.8	0.2	22.2	1.1
	09/08/16	09/15/16	0.6	0.2	18.5	1.0
	09/15/16	09/22/16	0.7	0.2	21.0	1.0
	09/22/16	09/29/16	0.7	0.2	18.7	1.0
Boundary Locations						
Atomic City	06/30/16	07/07/16	0.9	0.2	27.1	1.1
	07/07/16	07/14/16	1.0	0.2	20.2	1.0
	07/14/16	07/21/16	1.2	0.2	26.1	1.1
	07/21/16	07/28/16	1.4	0.3	28.1	1.2
	07/28/16	08/04/16	2.5	0.3	27.7	1.2
	08/04/16	08/11/16	1.8	0.3	30.3	1.2
	08/11/16	08/18/16	1.8	0.3	36.5	1.3
	08/18/16	08/25/16	1.7	0.3	24.4	1.1
	08/25/16	09/01/16	1.4	0.3	31.4	1.2
	09/01/16	09/08/16	1.0	0.2	24.5	1.1
	09/08/16	09/15/16	1.0	0.2	21.1	1.0
	09/15/16	09/22/16	0.8	0.2	25.4	1.1
	09/22/16	09/29/16	1.0	0.2	22.6	1.0
Howe	06/30/16	07/07/16	NS[1]	NS[1]	NS[1]	NS[1]
	07/07/16	07/14/16	0.9	0.2	16.6	1.0
	07/14/16	07/21/16	1.0	0.2	22.9	1.1
	07/21/16	07/28/16	0.9	0.2	25.2	1.2
	07/28/16	08/04/16	4.4	0.6	26.4	1.7
	08/04/16	08/11/16	1.7	0.3	28.9	1.2
	08/11/16	08/18/16	1.6	0.3	31.0	1.3
	08/18/16	08/25/16	2.0	0.3	22.0	1.1
	08/25/16	09/01/16	1.5	0.3	25.9	1.2
	09/01/16	09/08/16	1.0	0.2	21.2	1.1
	09/08/16	09/15/16	0.7	0.2	17.7	1.0
	09/15/16	09/22/16	0.6	0.2	22.4	1.1
	09/22/16	09/29/16	0.4	0.2	18.8	1.0

[1]NS – No sample – Sampler not restarted the 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, third quarter, 2016.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	06/30/16	07/07/16	1.0	0.2	27.8	1.2
	07/07/16	07/14/16	0.9	0.2	17.3	1.0
	07/14/16	07/21/16	NS[1]	NS[1]	NS[1]	NS[1]
	07/21/16	07/28/16	1.1	0.3	26.4	1.2
	07/28/16	08/04/16	2.2	0.4	28.9	1.5
	08/04/16	08/11/16	1.3	0.3	27.6	1.2
	08/11/16	08/18/16	1.4	0.3	32.4	1.3
	08/18/16	08/25/16	1.6	0.3	23.9	1.1
	08/25/16	09/01/16	1.1	0.3	28.7	1.3
	09/01/16	09/08/16	1.0	0.2	22.6	1.1
	09/08/16	09/15/16	0.7	0.2	18.6	1.0
	09/15/16	09/22/16	0.8	0.2	24.5	1.1
	09/22/16	09/29/16	0.6	0.2	20.7	1.1
Mud Lake	06/30/16	07/07/16	1.5	0.3	36.8	1.4
	07/07/16	07/14/16	1.4	0.3	23.9	1.1
	07/14/16	07/21/16	1.5	0.3	34.4	1.3
	07/21/16	07/28/16	1.2	0.3	30.8	1.3
	07/28/16	08/04/16	3.2	0.5	38.4	1.9
	08/04/16	08/11/16	1.5	0.3	34.2	1.3
	08/11/16	08/18/16	2.3	0.4	41.9	1.5
	08/18/16	08/25/16	R[1]	R[1]	R[1]	R[1]
	08/25/16	09/01/16	2.7	0.5	45.8	2.1
	09/01/16	09/08/16	1.4	0.3	34.2	1.3
	09/08/16	09/15/16	0.9	0.2	26.0	1.1
	09/15/16	09/22/16	1.3	0.3	33.6	1.3
	09/22/16	09/29/16	1.5	0.3	33.0	1.3
Distant Locations						
Craters of the Moon	06/30/16	07/07/16	0.8	0.2	24.8	1.1
	07/07/16	07/14/16	0.9	0.2	20.3	1.0
	07/14/16	07/21/16	0.8	0.2	25.8	1.1
	07/21/16	07/28/16	1.4	0.3	36.4	1.3
	07/28/16	08/04/16	2.7	0.4	26.0	1.1
	08/04/16	08/11/16	1.7	0.3	29.8	1.2
	08/11/16	08/18/16	2.2	0.3	38.2	1.3
	08/18/16	08/25/16	1.5	0.3	28.7	1.2
	08/25/16	09/01/16	NS[1]	NS[1]	NS[1]	NS[1]
	09/01/16	09/08/16	0.9	0.2	29.3	1.2
	09/08/16	09/15/16	1.1	0.4	27.5	1.8
	09/15/16	09/22/16	R[2]	R[2]	R[2]	R[2]
	09/22/16	09/29/16	0.4	0.2	22.2	1.1

[1]NS – No sample – Sampler not restarted the previous week.
[1]R – Results rejected due to insufficient sample volume caused by equipment shutdown due to filter loading from wildfires.
[2]R – Results rejected due to insufficient sample volume caused by equipment failure.

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

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	06/30/16	07/07/16	1.1	0.2	20.8	1.0
	07/07/16	07/14/16	1.0	0.2	14.5	0.9
	07/14/16	07/21/16	1.0	0.2	19.4	1.0
	07/21/16	07/28/16	1.1	0.3	22.9	1.1
	07/28/16	08/04/16	1.4	0.3	21.9	1.1
	08/04/16	08/11/16	1.1	0.2	22.1	1.1
	08/11/16	08/18/16	1.8	0.3	30.8	1.2
	08/18/16	08/25/16	1.8	0.3	20.3	1.0
	08/25/16	09/01/16	3.4	0.5	25.8	1.6
	09/01/16	09/08/16	NS[3]	NS[3]	NS[3]	NS[3]
	09/08/16	09/15/16	NS[3]	NS[3]	NS[3]	NS[3]
	09/15/16	09/22/16	NS[3]	NS[3]	NS[3]	NS[3]
	09/22/16	09/29/16	NS[3]	NS[3]	NS[3]	NS[3]
Idaho Falls - HVP 3804	06/30/16	07/07/16	1.3	0.3	31.9	1.3
	07/07/16	07/14/16	1.1	0.2	23.7	1.1
	07/14/16	07/21/16	1.3	0.3	35.1	1.6
	07/21/16	07/28/16	1.1	0.3	35.9	1.4
	07/28/16	08/04/16	1.7	0.3	32.6	1.3
	08/04/16	08/11/16	1.9	0.3	35.7	1.3
	08/11/16	08/18/16	1.7	0.3	38.2	1.4
	08/18/16	08/25/16	2.1	0.4	30.9	1.3
	08/25/16	09/01/16	1.4	0.3	35.7	1.4
	09/01/16	09/08/16	1.3	0.3	29.5	1.2
	09/08/16	09/15/16	1.1	0.3	22.1	1.1
	09/15/16	09/22/16	1.4	0.3	30.1	1.2
	09/22/16	09/29/16	0.8	0.2	25.5	1.2
Idaho Falls - HVP 4304[2]	06/30/16	07/07/16	NS[3]	NS[3]	NS[3]	NS[3]
	07/07/16	07/14/16	NS[3]	NS[3]	NS[3]	NS[3]
	07/14/16	07/21/16	NS[3]	NS[3]	NS[3]	NS[3]
	07/21/16	07/28/16	NS[3]	NS[3]	NS[3]	NS[3]
	07/28/16	08/04/16	NS[3]	NS[3]	NS[3]	NS[3]
	08/04/16	08/11/16	NS[3]	NS[3]	NS[3]	NS[3]
	08/11/16	08/18/16	NS[3]	NS[3]	NS[3]	NS[3]
	08/18/16	08/25/16	NS[3]	NS[3]	NS[3]	NS[3]
	08/25/16	09/01/16	NS[3]	NS[3]	NS[3]	NS[3]
	09/01/16	09/08/16	1.3	0.3	29.6	1.2
	09/08/16	09/15/16	1.1	0.3	24.7	1.1
	09/15/16	09/22/16	1.1	0.3	31.8	1.3
	09/22/16	09/29/16	0.9	0.2	25.9	1.1

[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, third quarter, 2016.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/h)
Arco	15.1	2.2
Craters of the Moon	10.3	0.9
Big Lost River Rest Area	16.7	1.8
Van Buren Avenue	15.7	2.2
Experimental Field Station	14.8	1.1
Main Gate	15.1	3.2
Atomic City	12.7	1.7
Taber	16.6, 16.8	
Blackfoot	11.6	1.3
Ft. Hall	11.2	3.4
Idaho Falls	9.1	1.2
Mud Lake/ Terreton	13.1	1.5
Monteview	15.0	2.7
Sand Dunes Tower	13.5	3.5
Howe Met. Tower	12.4	0.5
MP276 -20	17.4	2.2
MP274 -20	12.9	1.4
MP272 -20	12.2	1.5
MP270 -20	14.4	0.7
MP268 -20	15.2	2.8
MP266 -20	13.7	2.3
MP264 -20	14.3, 17.2	
MP270 -20/26	17.2	2.6
MP268 -20/26	14.1	2.0
MP266 -20/26	14.8, 16.7	
MP263 -20/26	16.4	2.7
MP261 -20/26	14.7	2.2
MP259 -20/26	14.3, 15.3	
MFC (EBR II)	18.0, 19.1	
EBR I	11.0	2.5
RWMC	16.1	2.0
CFA	13.7, 14.3	
CITRC (PBF)	15.4	3.0
INTEC	14.9	2.6
ATR (TRA)	10.0, 13.7	
NRF	15.3	0.4
TAN/SMC	11.7	2.4
Mud Lake Bank of Commerce	13.3	2.9
MP43-33	14.4	1.4
MP41-33	15.2	2.5
MP39-33	13.8	2.3
MP 37-33	10.8, 11.6	
MP35-33	13.7	1.2
MP33-33	12.8, 13.1	
MP31-33	13.2	0.5
MP29-33	14.2	3.4
MP27-33	12.4	3.2
MP25-33	14.7	2.1
MP23-33	10.3	2.6
Base of Howe	15.5	1.7

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Rover	15.8,16.8	
Hamer	13.1, 13.7	
Sugar City	16.7, 17.7	
Roberts	12.5	2.5
Big Southern Butte	14.8, 16.1	

[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