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 |
| CWI | - | CH2M-WG Idaho, LLC |
| DEQ-INL OP | - | The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program |
| DOE | - | U.S. Department of Energy |
| EBR I & II | - | Experimental Breeder Reactors I & II |
| EFS | - | Experimental Field Station |
| EIC | - | electret ionization chamber |
| EML | - | Environmental Monitoring Laboratory |
| EPA | - | Environmental Protection Agency |
| ESER | - | Environmental Surveillance, Education and Research Program |
| ESP | - | Environmental Surveillance Program |
| ESRPA | - | Eastern Snake River Plain Aquifer |
| GSS | - | Gonzales-Stoller Surveillance, LLC |
| HPIC | - | high-pressure ion chamber |
| LLD | - | lower limit of detection |
| IBL | - | Idaho Bureau of Laboratories |
| ICPP | - | Idaho Chemical Processing Plant |
| INL | - | Idaho National Laboratory |
| INTEC | - | Idaho Nuclear Technology and Engineering Center |
| LSC | - | liquid scintillation counting |
| MFC | - | Materials and Fuels Complex |
| µg/L | - | micrograms per liter |
| mg/L | - | milligrams per liter |
| mrem | - | millirem or 1/1000$^{th}$ of a rem |
| mR | - | milliRoentgen |
| mR/hr | - | milliRoentgen per hour |
| µR/hr | - | microRoentgen per hour |
| MCL | - | maximum contaminant level |
| MDA | - | minimum detectable activity |
| MDC | - | minimum detectable concentration |
| 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 |
| 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 |
| RWMC | - | Radioactive Waste Management Complex |
| RTC | - | Reactor Technology Complex |
| SD | - | standard deviation |
| SMCL | - | secondary maximum contaminant level |
| TAN | - | Test Area North |
| TDS | - | total dissolved solids |
| TMI | - | Three Mile Island |
| TRA | - | Test Reactor Area |
| TSP | - | total suspended particulate |
| TSS | - | total suspended solids |
| USGS | - | U.S. Geological Survey |
| VOC | - | volatile organic compound |
| WLAP | - | Wastewater Land Application Permit |

# Introduction

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

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

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

# Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the fourth quarter, 2014 (**Figure 1**). These stations employed instrumentation for collecting airborne particulate matter, gaseous radioiodine, precipitation, and water vapor for tritium analysis (**Table 1**). The Shoshone-Bannock Tribes operated an air monitoring station located at Fort Hall. The Fort Hall station uses identical instrumentation and sampling protocol as the ten stations operated by the ESP. The DEQ-INL OP reports the Fort Hall station data as an additional distant site.

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

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the fourth quarter of 2014 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 fourth 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. There is one individual sample within the weighted mean that exceeded MDC located at Experimental Field Station: 0.89 pCi/$m^3$ (MDC 0.84 pCi/$m^3$). Results are well below the DEQ-INL OP action level for atmospheric tritium 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 fourth quarter of 2014. 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 fourth quarter of 2014. Tritium and Cesium-137 analysis results are presented in **Table 5**.

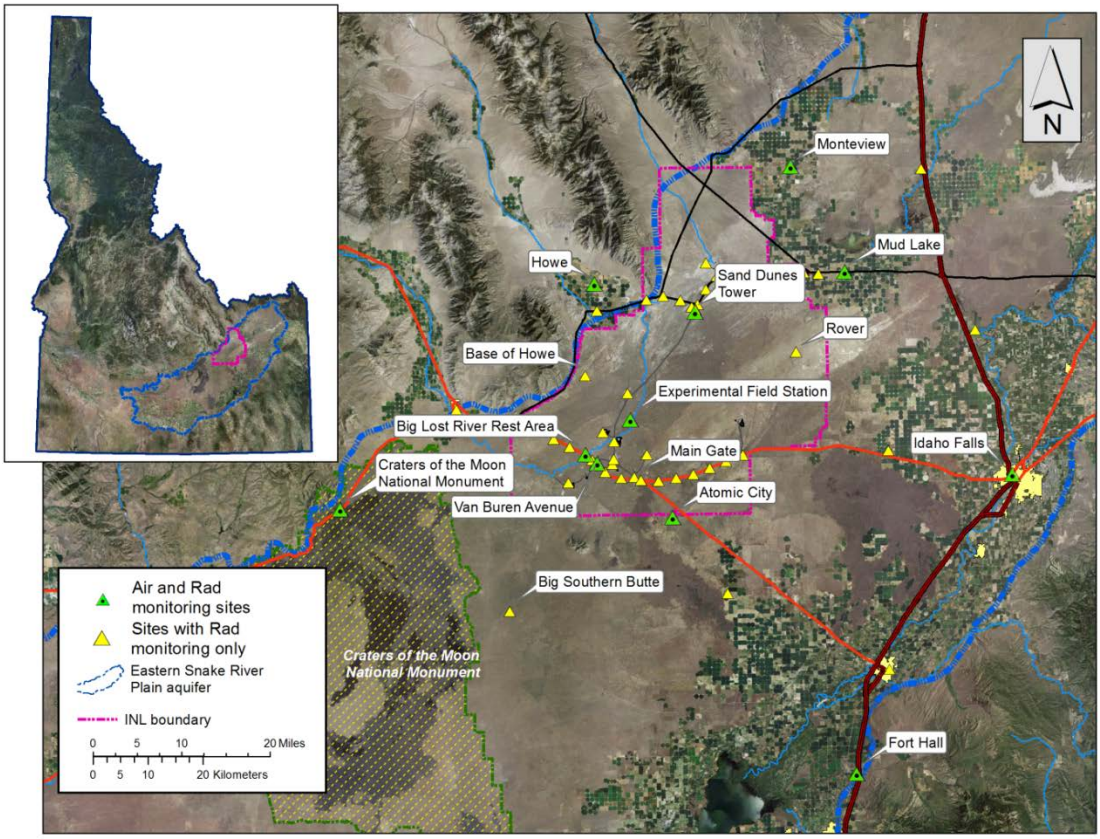


**Figure 1. Air and radiation monitoring sites.**

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

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

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

**Table 2. Range of gross alpha and gross beta concentrations for TSP filters, fourth quarter, 2014.**

| Station Location | Concentration | | | | | |
|---|---|---|---|---|---|---|
| | Gross Alpha | | | Gross Beta | | |
| **On-Site Locations** | | | | | | |
| Big Lost River Rest Area | 0.6 | - | 4.6 | 18.2 | - | 78.9 |
| Experimental Field Station | 0.3 | - | 4.9 | 15.6 | - | 83.3 |
| Sand Dunes Tower | 0.2 | - | 3.7 | 13.4 | - | 60.5 |
| Van Buren Avenue | 0.3 | - | 3.7 | 14.1 | - | 65.0 |
| **Boundary Locations** | | | | | | |
| Atomic City | 0.4 | - | 4.6 | 15.3 | - | 70.8 |
| Howe | 0.4 | - | 3.4 | 16.6 | - | 52.9 |
| Monteview | 0.5 | - | 3.8 | 17.9 | - | 65.4 |
| Mud Lake | 0.7 | - | 5.0 | 23.8 | - | 74.7 |
| **Distant Locations** | | | | | | |
| Craters of the Moon | 0.2 | - | 5.0 | 15.1 | - | 80.7 |
| Fort Hall[1] | 0.3 | - | 3.0 | 12.6 | - | 44.4 |
| Idaho Falls – HVP 3804 | 0.5 | - | 3.9 | 19.0 | - | 67.6 |
| Idaho Falls – HVP 4304 | 0.6 | - | 4.9 | 21.0 | - | 81.7 |

[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, fourth quarter, 2014.**

| Station Location | Naturally Occurring Radionuclide Beryllium-7 | | Man-Made Gamma Emitting Radionuclides |
|---|---|---|---|
| | Concentration | ± 2 SD | |
| **On-site Locations** | | | |
| Big Lost River Rest Area | 60.5 | 3.2 | <MDC[2] |
| Experimental Field Station | 44.2 | 2.5 | <MDC |
| Sand Dunes Tower | 38.6 | 2.2 | <MDC |
| Van Buren Avenue | 40.4 | 2.3 | <MDC |
| **Boundary Locations** | | | |
| Atomic City | 48.5 | 2.6 | <MDC |
| Howe | 43.5 | 2.4 | <MDC |
| Monteview | 46.5 | 2.6 | <MDC |
| Mud Lake | 59.2 | 3.1 | <MDC |
| **Distant Locations** | | | |
| Craters of the Moon | 39.9 | 2.3 | <MDC |
| Fort Hall[1] | 35.7 | 2.1 | <MDC |
| Idaho Falls – HVP 3804 | 61.5 | 3.3 | <MDC |
| Idaho Falls – HVP 4304 | 42.4 | 2.3 | <MDC |

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (5-10)x$10^{-5}$ pCi/$m^3$.
Note: Concentrations are reported in 1 x $10^{-3}$ pCi/$m^3$ with associated uncertainty (± 2 SD), and minimum detectable concentration (MDC).

**Table 4. Tritium concentrations in air from atmospheric moisture, fourth quarter, 2014**

| Station Location | Tritium | | |
|---|---|---|---|
| | Concentration | ± 2 SD | MDC |
| **On-site Locations** | | | |
| Big Lost River Rest Area | 0.16 | 0.30 | 0.52 |
| Experimental Field Station | 0.43 | 0.40 | 0.66 |
| Sand Dunes Tower | 0.00 | 0.26 | 0.46 |
| Van Buren Avenue | 0.22 | 0.40 | 0.65 |
| **Boundary Locations** | | | |
| Atomic City | 0.30 | 0.40 | 0.64 |
| Howe | 0.02 | 0.36 | 0.60 |
| Mud Lake | 0.17 | 0.36 | 0.60 |
| Monteview | 0.09 | 0.34 | 0.57 |
| **Distant Locations** | | | |
| Craters of the Moon | 0.12 | 0.14 | 0.23 |
| Fort Hall[1] | 0.02 | 0.49 | 0.81 |
| Idaho Falls | 0.19 | 0.36 | 0.61 |

[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, fourth quarter, 2014.**

| Station Location | Tritium | | | Cesium-137 | | |
|---|---|---|---|---|---|---|
| | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| **On-site Locations** | | | | | | |
| Big Lost River Rest Area | -50 | 90 | 150 | 0.4 | 1.6 | 2.8 |
| **Boundary Locations** | | | | | | |
| Atomic City | -60 | 90 | 150 | -0.1 | 1.2 | 2.2 |
| Howe | -50 | 90 | 150 | 2.0 | 2.1 | 3.4 |
| Monteview | 20 | 110 | 180 | -0.1 | 1.3 | 2.2 |
| Mud Lake | 80 | 90 | 150 | 0.9 | 1.9 | 3.2 |
| **Distant Locations** | | | | | | |
| Idaho Falls | 10 | 90 | 150 | -0.6 | 1.8 | 3.1 |

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 fourth quarter of 2014 (**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 EIC's and an HPIC, both of which belong to the DEQ-INL OP. The DEQ-INL OP reports these results.

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 fourth quarter 2014. **Table 8** lists the EIC monitoring results for fourth quarter 2014. 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[1] | ■ | ■ |
| Idaho Falls | ■ | ■ |

[1]HPIC operated by Shoshone-Bannock Tribes with the EICs maintained by DEQ-INL OP.

**Table 7. Average gamma exposure rates, fourth quarter, 2014, from HPIC network.**

| Station Location | Exposure Rate (µR/hr) | |
|---|---|---|
| | Quarterly Average | ± 2 SD |
| **On-site Locations** | | |
| Base of Howe | 15.6 | 1.9 |
| Big Lost River Rest Area | 15.2 | 1.2 |
| Main Gate | 14.6 | 1.3 |
| Rover | 16.3 | 1.6 |
| Sand Dunes Tower | 13.3 | 1.0 |
| **Boundary Locations** | | |
| Atomic City | 13.2 | 1.2 |
| Big Southern Butte | 14.7 | 1.8 |
| Howe Met Tower | 12.7 | 1.0 |
| Monteview | 13.3 | 1.1 |
| Mud Lake/Terreton | 14.3 | 1.2 |
| **Distant Locations** | | |
| Fort Hall[1] | 12.4 | 1.0 |
| Idaho Falls | 12.8 | 1.4 |

[1]Operated by Shoshone-Bannock Tribes.

**Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2014.**

| Station Location | Exposure Rate (µR/hr) | |
|---|---|---|
| | Quarterly Average[1] | ± 2 SD |
| **On-site Locations** | | |
| Base of Howe | 15.8, 16.4 | |
| Big Lost River Rest Area | 12.7 | 2.8 |
| Experimental Field Station | 13.6 | 3.4 |
| Main Gate | 14.5 | 1.9 |
| Rover | 14.3 | 0.7 |
| Sand Dunes Tower | 13.6 | 1.2 |
| Van Buren Avenue | 14.5 | 2.5 |
| **Boundary Locations** | | |
| Atomic City | 11.6 | 3.1 |
| Big Southern Butte | 12.6 | 3.1 |
| Howe Met Tower | 11.9, 12.9 | |
| Monteview | 10.2, 11.0 | |
| Mud Lake / Terreton | 12.5 | 1.2 |
| **Distant Locations** | | |
| Craters of the Moon | 12.7, 13.7 | |
| Fort Hall[2] | 11.3 | 2.5 |
| Idaho Falls | 12.4 | 3.6 |

[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.
[2]Station operated by Shoshone-Bannock Tribes.

# Water Monitoring

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 fourth quarter of 2014, 2 up-gradient, 18 facility, 3 boundary, 5 distant, and 1 surface water location 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 ($^{238}$Pu, $^{239/240}$Pu), uranium ($^{234}$U, $^{235}$U, and $^{238}$U), and americium ($^{241}$Am); and beta emitting radionuclides technetium-99 ($^{99}$Tc) and strontium-90 ($^{90}$Sr), 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 3 facility locations and was within the range of concentrations observed for naturally-occurring radioactivity. The EPA maximum contaminant level (MCL) for alpha particles is 15 pCi/L.

Gross beta radioactivity was detected at every location sampled this quarter. Concentrations observed at these locations, including up-gradient, facility, boundary, distant and surface water, are consistent with the expected ranges found in each area. The MCL for beta and gamma radioactivity is 4 mrem/year, equivalent to 8 pCi/L if the source is $^{90}$Sr; 900 pCi/L if $^{99}$Tc; 20,000 pCi/L if tritium ($^{3}$H); or 200 pCi/L if $^{137}$Cs. Man-made, gamma emitting radioactivity was not detected at any of the sampled locations. Results for gross alpha; gross beta; and man-made, gamma emitting $^{137}$Cs are shown in **Table 9**.

Four sites were sampled for isotopes of uranium (**Table 10**). All sites had detectable results for $^{234}$U and $^{238}$U. Two sites, A11A31 and M3S, showed results for $^{235}$U that were greater than the MDC; however, those values are less than three standard deviations and are considered non-detections. The results observed at the four sample sites cannot be distinguished from background values, which means the uranium found in the samples is likely to be naturally occurring.

Three of the thirteen samples analyzed for $^{90}$Sr had detectable results this quarter, with all three collected from areas of known contamination (**Table 11**). All eight locations sampled for $^{99}$Tc had detectable results this quarter that were within the expected ranges of concentrations (**Table 12**).

Using the standard analytical method, $^{3}$H was detected at thirteen facility locations (**Table 13**). Tritium levels found at these wells are similar to historic concentrations for these sites and are consistent with INL waste disposal influences at each facility. Sample location TAN-10A has shown a slight increase in $^{3}$H over the last few years with concentrations of 280±120 pCi/L in 2009 up to 540±110 pCi/L in 2013. For 2014 $^{3}$H concentrations held steady at 540±120 pCi/L. Selected water samples with tritium concentrations not measurable using the standard method (typically a MDC of 130 pCi/L) are analyzed using an electrolytic enrichment method with a much lower MDC of 10 to 14 pCi/L. There were two samples analyzed using the enrichment method for the current quarter, as well as sample analyses from seventeen sites collected during previous quarters that were completed and presented this quarter (**Table 14**). A backlog of 19 samples remains.

Samples were also analyzed for metals and the results shown in **Table 15**. All results are within their expected ranges. Common ion results are shown in **Table 16** and nutrient results are shown in **Table 17**. All results are consistent with the expected values at each location.

Volatile Organic Compounds (VOCs) were sampled at five locations this quarter in an area of known contamination near RWMC. Four of the five locations had detectable concentrations for two analytes, carbon tetrachloride and trichloroethylene. Results are illustrated in **Table 18** and are consistent with previous concentrations found at these locations. The background concentrations for VOCs should be undetectable. The results discussed in this section only refer to detectable VOC concentrations; a complete list of analyses is shown in **Appendix C**.

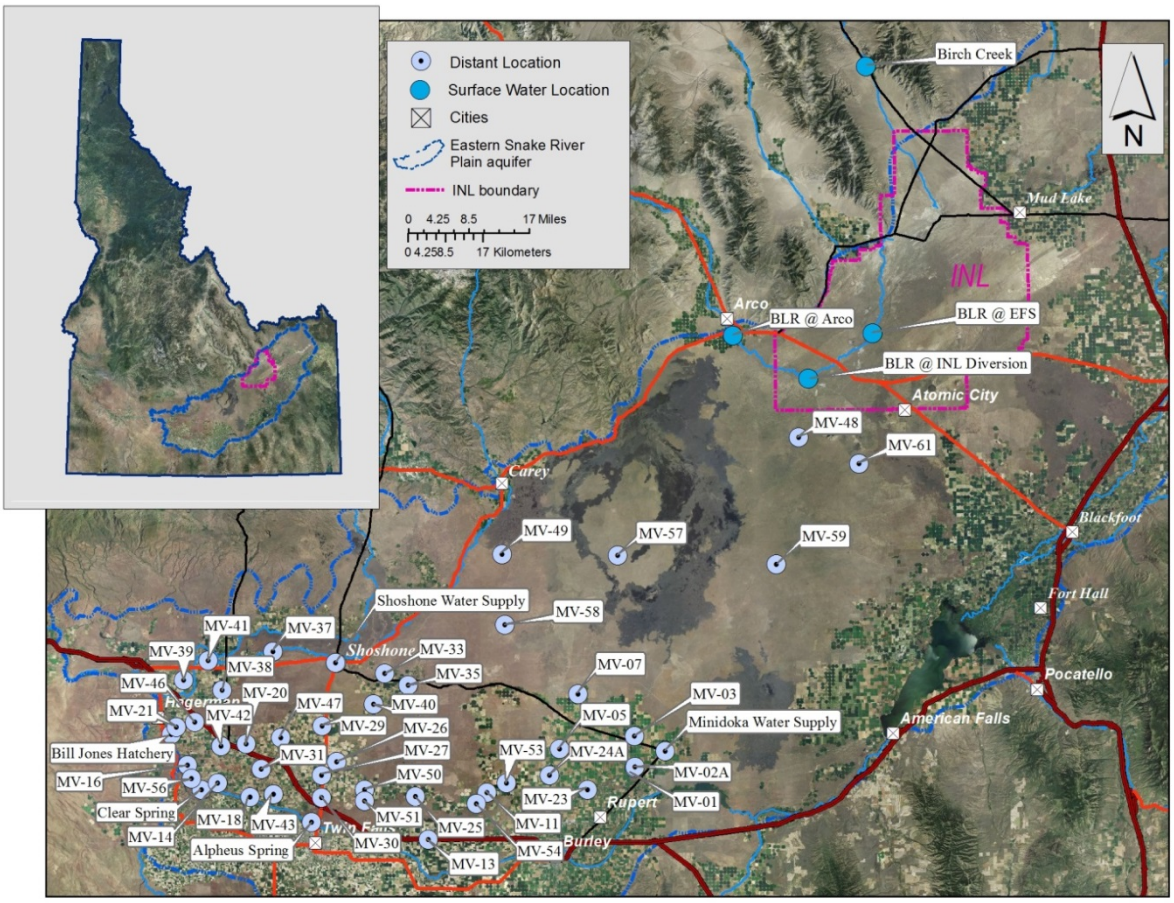


**Figure 2. Distant and Surface Water monitoring locations.**

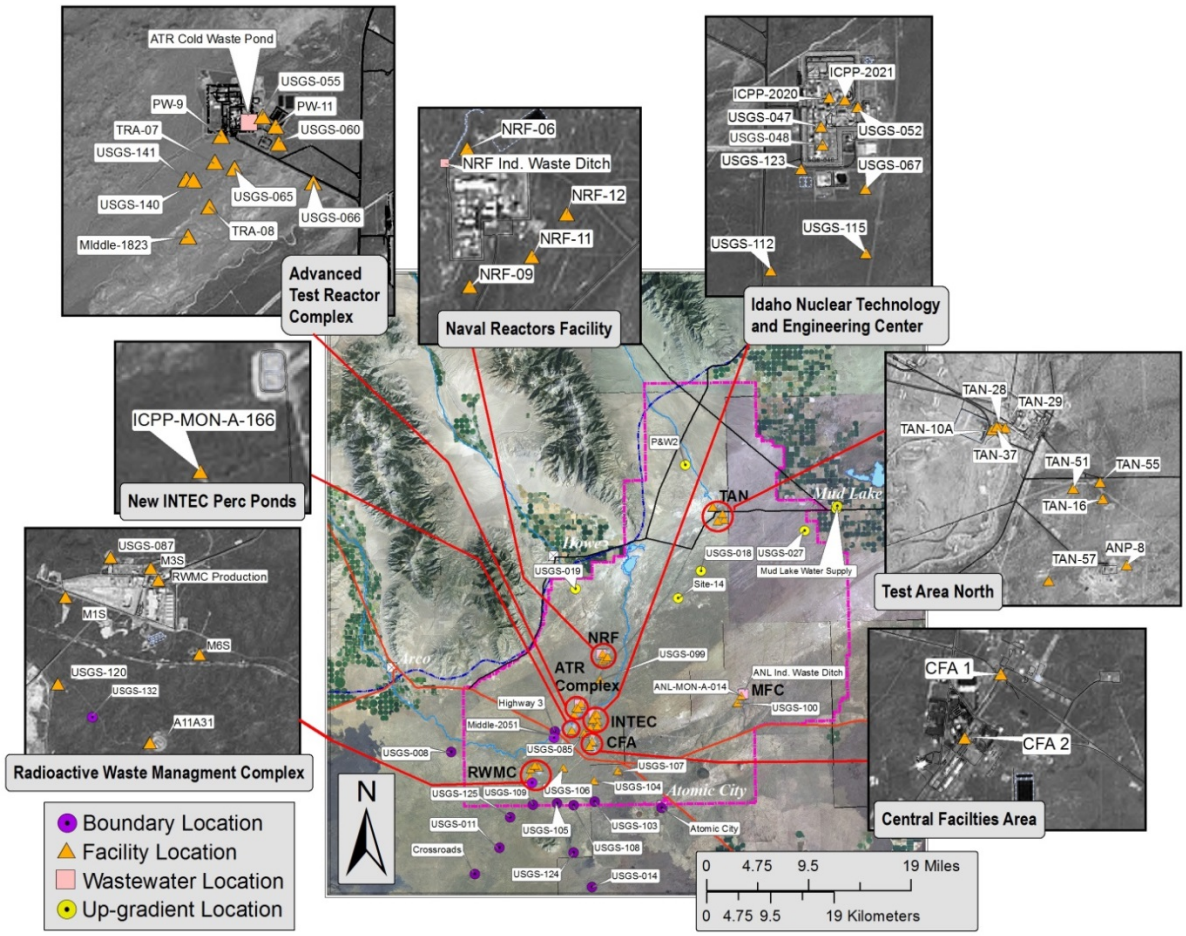


**Figure 3. Upgradient, facility, boundary, and wastewater monitoring locations.**

**Table 9. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations for water samples, fourth quarter, 2014.**

| 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 | 11/20/2014 | 0.1 | U | 0.8 | 4.4 | | 0.8 | 1.1 | U | 1.8 |
| Site-14 | 10/20/2014 | 0.0 | U | 0.8 | 3.6 | | 0.8 | 0.5 | U | 1.6 |
| **Facility** | | | | | | | | | | |
| A11A31 | 11/4/2014 | 0.3 | U | 0.9 | 4.7 | | 0.9 | 1.5 | U | 1.8 |
| CFA 2 | 10/22/2014 | 7.1 | | 3.2 | 8.3 | | 2.5 | 0.6 | U | 1.5 |
| M1S | 11/3/2014 | 2.2 | | 1.0 | 4.3 | | 0.9 | 2.2 | U | 2.1 |
| M3S | 11/3/2014 | 0.5 | U | 0.9 | 4.5 | | 0.9 | -0.7 | U | 1.2 |
| M6S | 11/4/2014 | -0.2 | U | 0.8 | 3.7 | | 0.9 | 1.3 | U | 1.6 |
| Middle-1823 | 10/6/2014 | 0.8 | U | 1.0 | 2.5 | | 0.9 | 0.4 | U | 2.1 |
| PW-11 | 10/6/2014 | 1.4 | U | 1.3 | 5.8 | | 1.0 | 0.1 | U | 1.7 |
| PW-9 | 10/20/2014 | 2.1 | U | 1.7 | 5.4 | | 1.1 | -0.4 | U | 1.3 |
| RWMC Production | 10/16/2014 | 0.9 | U | 0.7 | 2.7 | | 0.7 | 1.1 | U | 1.5 |
| TAN-10A | 10/14/2014 | 2.9 | U | 2.3 | 142.4 | | 4.6 | -0.3 | U | 1.5 |
| TRA-08 | 10/6/2014 | 1.4 | U | 1.2 | 5.6 | | 1.0 | 1.4 | U | 1.4 |
| USGS-055 | 10/6/2014 | 1.2 | U | 1.5 | 97.4 | | 2.6 | 0.3 | U | 1.4 |
| USGS-060 | 10/20/2014 | 1.6 | U | 1.2 | 4.7 | | 1.0 | 0.1 | U | 1.2 |
| USGS-066 | 10/22/2014 | 5.0 | | 1.8 | 5.9 | | 1.1 | 0.5 | U | 1.9 |
| USGS-104 | 10/21/2014 | -0.6 | U | 0.7 | 2.7 | | 0.8 | -0.6 | U | 2.0 |
| USGS-112 | 10/7/2014 | 0.9 | U | 1.1 | 23.6 | | 1.4 | -0.9 | U | 1.9 |
| USGS-115 | 10/7/2014 | 0.8 | U | 1.0 | 8.3 | | 1.0 | 1.1 | U | 1.8 |
| USGS-120 | 10/14/2014 | -0.9 | U | 1.0 | 3.1 | | 0.9 | -0.7 | U | 1.4 |
| **Boundary** | | | | | | | | | | |
| Highway 3 | 10/21/2014 | 1.4 | U | 1.1 | 4.4 | | 0.9 | 1.6 | U | 1.6 |
| USGS-014 | 10/14/2014 | 1.3 | U | 1.2 | 2.8 | | 1.0 | 1.5 | U | 2.0 |
| USGS-125 | 10/14/2014 | -0.3 | U | 1.0 | 2.9 | | 0.9 | 0.8 | U | 1.5 |
| **Distant** | | | | | | | | | | |
| Alpheus Spring | 11/17/2014 | 1.1 | U | 1.2 | 6.2 | | 1.1 | 0.5 | U | 2.5 |
| Bill Jones Hatchery | 11/17/2014 | 0.5 | U | 1.1 | 4.0 | | 0.9 | 1.6 | U | 1.4 |
| Clear Spring | 11/17/2014 | 0.5 | U | 1.3 | 4.2 | | 1.0 | 2.3 | U | 1.6 |
| Minidoka Water Supply | 11/17/2014 | 1.0 | U | 1.3 | 3.2 | | 0.9 | 0.2 | U | 1.8 |
| Shoshone Water Supply | 11/17/2014 | 0.8 | U | 1.2 | 3.3 | | 0.9 | -0.4 | U | 1.5 |
| **Surface water** | | | | | | | | | | |
| Birch Creek | 10/16/2014 | 0.8 | U | 1.0 | 1.8 | | 0.8 | -0.4 | U | 1.2 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

**Table 10. Reported concentrations of uranium isotopes in water samples, fourth quarter, 2014.**

| 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** | | | | | | | | | | |
| A11A31 | 11/4/2014 | 1.52 | | 0.36 | 0.038 | U* | 0.047 | 0.74 | | 0.22 |
| M1S | 11/3/2014 | 1.22 | | 0.39 | -0.002 | U | 0.094 | 0.59 | | 0.25 |
| M3S | 11/3/2014 | 0.93 | | 0.25 | 0.038 | U* | 0.047 | 0.58 | | 0.19 |
| M6S | 11/4/2014 | 1.36 | | 0.35 | 0.035 | U | 0.057 | 0.55 | | 0.19 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.
*The result is greater than the MDC but is less than 3 SD so is therefore considered a non-detection.

**Table 11. Reported concentrations of strontium-90 in water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Strontium-90 | | |
|---|---|---|---|---|
| | | Concentration[1,2] | | ±2 SD |
| **Facility** | | | | |
| CFA 2 | 10/22/2014 | 0.42 | U | 0.30 |
| Middle-1823 | 10/6/2014 | 0.19 | U | 0.30 |
| PW-11 | 10/6/2014 | 0.03 | U | 0.40 |
| PW-9 | 10/20/2014 | -0.02 | U | 0.29 |
| RWMC Production | 10/16/2014 | 0.09 | U | 0.29 |
| TAN-10A | 10/14/2014 | 55.0 | | 13.0 |
| TRA-08 | 10/6/2014 | 0.49 | U | 0.33 |
| USGS-055 | 10/6/2014 | 30.6 | | 7.3 |
| USGS-060 | 10/20/2014 | 0.47 | U | 0.34 |
| USGS-066 | 10/22/2014 | 0.02 | U | 0.29 |
| USGS-112 | 10/7/2014 | 7.2 | | 1.8 |
| USGS-115 | 10/7/2014 | 0.02 | U | 0.25 |
| USGS-120 | 10/14/2014 | 0.11 | U | 0.25 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

**Table 12. Reported concentrations of technetium-99 in water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Technetium-99 | | |
|---|---|---|---|---|
| | | Concentration[1,2] | | ±2 SD |
| **Facility** | | | | |
| A11A31 | 11/4/2014 | 0.7 | | 0.2 |
| CFA 2 | 10/22/2014 | 3.8 | | 0.2 |
| M1S | 11/3/2014 | 0.6 | | 0.2 |
| M3S | 11/3/2014 | 1.6 | | 0.2 |
| M6S | 11/4/2014 | 0.7 | | 0.2 |
| USGS-112 | 10/7/2014 | 2.2 | | 0.2 |
| USGS-115 | 10/7/2014 | 7.0 | | 0.3 |
| USGS-120 | 10/14/2014 | 1.3 | | 0.2 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L. Samples are filtered unless otherwise indicated.

**Table 13. Tritium concentrations for water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Tritium | | |
|---|---|---|---|---|
| | | Concentration[1,2] | | ±2 SD |
| **Up-gradient** | | | | |
| Mud Lake Water Supply | 11/20/2014 | 0 | U | 110 |
| Site-14 | 10/20/2014 | 70 | U | 110 |
| **Facility** | | | | |
| A11A31 | 11/4/2014 | 170 | U | 110 |
| CFA 2 | 10/22/2014 | 3600 | | 190 |
| M1S | 11/3/2014 | -200 | U | 100 |
| M3S | 11/3/2014 | 760 | | 120 |
| M6S | 11/4/2014 | 20 | U | 110 |
| Middle-1823 | 10/6/2014 | 780 | | 130 |
| PW-11 | 10/6/2014 | 1650 | | 140 |
| PW-9 | 10/20/2014 | 5200 | | 200 |
| RWMC Production | 10/16/2014 | 710 | | 110 |
| TAN-10A | 10/14/2014 | 540 | | 120 |
| TRA-08 | 10/6/2014 | 1230 | | 140 |
| USGS-055 | 10/6/2014 | 5220 | | 200 |
| USGS-060 | 10/20/2014 | -10 | U | 80 |
| USGS-066 | 10/22/2014 | 130 | U | 90 |
| USGS-104 | 10/21/2014 | 690 | | 120 |
| USGS-112 | 10/7/2014 | 790 | | 130 |
| USGS-115 | 10/7/2014 | 1050 | | 130 |
| USGS-120 | 10/14/2014 | 180 | | 110 |
| **Boundary** | | | | |
| Highway 3 | 10/21/2014 | -20 | U | 110 |
| USGS-014 | 10/14/2014 | 70 | U | 110 |
| USGS-125 | 10/14/2014 | 120 | U | 110 |
| **Distant** | | | | |
| Alpheus Spring | 11/17/2014 | 90 | U | 110 |
| Bill Jones Hatchery | 11/17/2014 | 20 | U | 110 |
| Clear Spring | 11/17/2014 | 130 | U | 110 |
| Minidoka Water Supply | 11/17/2014 | 160 | U | 110 |
| Shoshone Water Supply | 11/17/2014 | -40 | U | 110 |
| **Surface water** | | | | |
| Birch Creek | 10/16/2014 | 50 | U | 110 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

**Table 14. Enriched Tritium concentrations for water samples from current and previous sampling quarters.**

| Sample Location | Sample Date | Enriched Tritium | | |
|---|---|---|---|---|
| | | Concentration[1,2] | | ±2 SD |
| **Upgradient** | | | | |
| Mud Lake Water Supply | 5/15/2014 | 0 | U | 6 |
| Site-14 | 10/20/2014 | -1 | U | 7 |
| **Facility** | | | | |
| ICPP-MON-A-166 | 9/10/14 | 75 | | 9 |
| **Boundary** | | | | |
| USGS-103 (1269.4 ftbls[3]) | 6/14/2011 | 329 | | 15 |
| USGS-132 (763.0 ftbls) | 6/19/2012 | 220 | | 12 |
| Middle-2051 (1021.0 ftbls) | 6/20/2012 | 242 | | 14 |
| USGS-103 (1269.4 ftbls) | 6/25/2012 | 286 | | 15 |
| USGS-132 (763.0 ftbls) | 6/19/2013 | 214 | | 13 |
| Highway 3 | 10/21/2014 | 68 | | 10 |
| **Distant** | | | | |
| Bill Jones Hatchery | 8/13/2014 | 11 | U | 7 |
| Clear Spring | 8/13/2014 | 2 | U | 6 |
| Minidoka Water Supply | 8/13/2014 | -1 | U | 7 |
| Shoshone Water Supply | 8/13/2014 | 11 | | 6 |
| MV-27 | 8/20/2014 | 11 | U | 7 |
| MV-39 | 8/13/2014 | 14 | | 6 |
| MV-30 | 7/21/2014 | 24 | | 7 |
| MV-37 | 7/22/2014 | 72 | | 9 |
| MV-40 | 8/13/2014 | 8 | U | 8 |
| MV-50 | 7/21/2014 | 19 | | 7 |

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.
[3]ftbls = feet below land surface.

**Table 15. Reported metals concentrations in water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Concentration[1,2] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Arsenic | | Barium | | Chromium | | Iron | | Lead | | Manganese | | Selenium | | Zinc | |
| **Up-gradient** | | | | | | | | | | | | | | | | | |
| Site-14 | 10/20/2014 | <5.0 | U | 66 | | 5.6 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| **Facility** | | | | | | | | | | | | | | | | | |
| A11A31 | 11/4/2014 | <5.0 | U | 36 | | 13 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | 44 | |
| CFA 2 | 10/22/2014 | <5.0 | U | 110 | | 9.6 | | 28 | | <5.0 | U | 9.2 | | <10 | U | <5.0 | U |
| M1S | 11/3/2014 | <5.0 | U | 24 | | 34 | | 11 | | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| M3S | 11/3/2014 | <5.0 | U | 48 | | 13 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| M6S | 11/4/2014 | <5.0 | U | 30 | | 28 | | 30 | | <5.0 | U | 2.9 | | <10 | U | <5.0 | U |
| Middle-1823 | 10/6/2014 | <5.0 | U | 69 | | 10 | | <10 | U | <5.0 | U | 3.3 | | <10 | U | <5.0 | U |
| PW-11 | 10/6/2014 | <5.0 | U | 94 | | 13 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | 9.5 | |
| PW-9 | 10/20/2014 | <5.0 | U | 57 | | 33 | | <10 | U | <5.0 | U | 64 | | <10 | U | <5.0 | U |
| RWMC Production | 10/16/2014 | <5.0 | U | 42 | | 13 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| TAN-10A | 10/14/2014 | <5.0 | U | 260 | | <5.0 | U | 1500 | | <5.0 | U | 890 | | <10 | U | <5.0 | U |
| TRA-08 | 10/6/2014 | <5.0 | U | 50 | | 15 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | 6.3 | |
| USGS-055 | 10/6/2014 | 7.4 | | 92 | | 19 | | 17 | | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-060 | 10/20/2014 | 8.4 | | 88 | | 5.0 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-066 | 10/22/2014 | <5.0 | U | 48 | | 8.3 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-104 | 10/21/2014 | <5.0 | U | 34 | | 8.7 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-112 | 10/7/2014 | <5.0 | U | 92 | | 12 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-115 | 10/7/2014 | <5.0 | U | 62 | | 7.2 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | 520 | |
| USGS-120 | 10/14/2014 | <5.0 | U | 44 | | 10 | | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| **Boundary** | | | | | | | | | | | | | | | | | |
| Highway 3 | 10/21/2014 | <5.0 | U | 56 | | <5.0 | U | <10 | U | <5.0 | U | <2.0 | U | <10 | U | 61 | |
| USGS-014 | 10/14/2014 | <5.0 | U | 23 | | <5.0 | U | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | U |
| USGS-125 | 10/14/2014 | <5.0 | U | 36 | | <5.0 | U | 110 | | <5.0 | U | 21 | | <10 | U | <5.0 | U |
| **Surface water** | | | | | | | | | | | | | | | | | |
| Birch Creek | 10/16/2014 | <5.0 | U | 67 | | <5.0 | U | <10 | U | <5.0 | U | <2.0 | U | <10 | U | <5.0 | 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 16. Reported common ion concentrations in water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Concentration[1,2] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Calcium | | Magnesium | | Sodium | | Potassium | | Fluoride | | Chloride | | Sulfate | | Alkalinity[3] | |
| **Up-gradient** | | | | | | | | | | | | | | | | | |
| Site-14* | 10/20/2014 | 33 | | 13 | | 14 | | 3.0 | | 0.515 | | 10.2 | | 25.8 | | 126 | |
| **Facility** | | | | | | | | | | | | | | | | | |
| A11A31* | 11/4/2014 | 37 | | 16 | | 21 | | 3.6 | | 0.222 | | 23.8 | | 41.4 | | 132 | |
| CFA 2* | 10/22/2014 | 81 | | 27 | | 35 | | 4.8 | | <0.20 | U | 144 | | 52.5 | | 133 | |
| M1S* | 11/3/2014 | 26 | | 12 | | 11 | | 2.4 | | 0.275 | | 13.8 | | 21.7 | | 95 | |
| M3S* | 11/3/2014 | 44 | | 15 | | 8.5 | | 2.7 | | 0.212 | | 15.9 | | 26.4 | | 140 | |
| M6S* | 11/4/2014 | 39 | | 19 | | 16 | | 3.4 | | 0.243 | | 29.6 | | 63.5 | | 99 | |
| Middle-1823* | 10/6/2014 | 54 | | 18 | | 11 | | 1.9 | | <0.20 | U | 12.3 | | 39.2 | | 173 | |
| PW-11* | 10/6/2014 | 94 | | 20 | | 20 | | 3.8 | | 0.258 | | 19.3 | | 161 | | 154 | |
| PW-9* | 10/20/2014 | 64 | | 19 | | 20 | | 2.6 | | <0.20 | U | 61.0 | | 68.6 | | 135 | |
| RWMC Production* | 10/16/2014 | 50 | | 17 | | 9.5 | | 2.8 | | 0.267 | | 26.7 | | 30.6 | | 137 | |
| TAN-10A* | 10/14/2014 | 86 | | 23 | | 43 | | 4.0 | | 0.235 | | 105 | | 36.3 | | 215 | |
| TRA-08* | 10/6/2014 | 48 | | 18 | | 11 | | 2.5 | | 0.206 | | 12.4 | | 51.5 | | 149 | |
| USGS-055* | 10/6/2014 | 80 | | 22 | | 16 | | 3.0 | | 0.254 | | 18.6 | | 131 | | 158 | |
| USGS-060* | 10/20/2014 | 69 | | 18 | | 13 | | 2.7 | | 0.277 | | 16.4 | | 104 | | 150 | |
| USGS-066* | 10/22/2014 | 94 | | 19 | | 15 | | 2.2 | | <0.20 | U | 21.9 | | 175 | | 138 | |
| USGS-104* | 10/21/2014 | 35 | | 14 | | 8.9 | | 2.6 | | 0.291 | | 15.1 | | 22.1 | | 119 | |
| USGS-112* | 10/7/2014 | 52 | | 14 | | 14 | | 2.7 | | 0.293 | | 21.2 | | 32.4 | | 152 | |
| USGS-115* | 10/7/2014 | 44 | | 13 | | 16 | | 3.9 | | 0.321 | | 46.5 | | 26.1 | | 111 | |
| USGS-120* | 10/14/2014 | 39 | | 18 | | 14 | | 3.2 | | 0.292 | | 15.6 | | 31.3 | | 140 | |
| **Boundary** | | | | | | | | | | | | | | | | | |
| Highway 3* | 10/21/2014 | 45 | | 12 | | 6.1 | | 2.4 | | 0.287 | | 6.39 | | 21.8 | | 140 | |
| USGS-014* | 10/14/2014 | 39 | | 16 | | 18 | | 3.0 | | 0.983 | | 22.9 | | 22.9 | | 137 | |
| USGS-125* | 10/14/2014 | 39 | | 16 | | 12 | | 2.8 | | 0.302 | | 12.8 | | 25.2 | | 136 | |
| **Surface water** | | | | | | | | | | | | | | | | | |
| Birch Creek* | 10/16/2014 | 45 | | 16 | | 5.4 | | 1.0 | | <0.20 | U | 4.7 | | 25.8 | | 145 | |

[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 17. Reported nutrient concentrations in water samples, fourth quarter, 2014**

| Sample Location | Sample Date | Concentration[1,2] | | | |
|---|---|---|---|---|---|
| | | Nitrite + Nitrate | | Phosphorus | |
| **Up-gradient** | | | | | |
| Site-14 | 10/20/2014 | 0.62 | | 0.016 | |
| **Facility** | | | | | |
| A11A31 | 11/4/2014 | 0.97 | | 0.020 | |
| CFA 2 | 10/22/2014 | 3.9 | | 0.017 | |
| M1S | 11/3/2014 | 1.0 | | 0.021 | |
| M3S | 11/3/2014 | 0.87 | | 0.025 | |
| M6S | 11/4/2014 | 1.9 | | 0.023 | |
| Middle-1823 | 10/6/2014 | 1.0 | | 0.029 | |
| PW-11 | 10/6/2014 | 1.6 | | 0.038 | |
| PW-9 | 10/20/2014 | 3.1 | | 0.0069 | |
| RWMC Production | 10/16/2014 | 1.0 | | 0.110 | |
| TAN-10A | 10/14/2014 | 0.085 | | 0.067 | |
| TRA-08 | 10/6/2014 | 1.0 | | 0.021 | |
| USGS-055 | 10/6/2014 | 1.5 | | 0.220 | |
| USGS-060 | 10/20/2014 | 1.4 | | 0.150 | |
| USGS-066 | 10/22/2014 | 1.6 | | 0.024 | |
| USGS-104 | 10/21/2014 | 0.86 | | 0.019 | |
| USGS-112 | 10/7/2014 | 1.2 | | 0.032 | |
| USGS-115 | 10/7/2014 | 1.6 | | 0.017 | |
| USGS-120 | 10/14/2014 | 0.88 | | 0.024 | |
| **Boundary** | | | | | |
| Highway 3 | 10/21/2014 | 0.47 | | 0.023 | |
| USGS-014 | 10/14/2014 | 1.3 | | 0.018 | |
| USGS-125 | 10/14/2014 | 0.63 | | 0.018 | |
| **Surface water** | | | | | |
| Birch Creek | 10/16/2014 | 0.25 | | 0.0051 | |

[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 18. Reported VOC concentrations in water samples, fourth quarter, 2014.**

| Sample Location | Sample Date | Concentrations[1,2] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1,1-Dichloroethene | Carbon tetrachloride | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Tetrachloroethylene (PERC) | Trichloroethylene | Vinyl chloride |
| A11A31 | 11/4/2014 | <0.5 | 2.0 | <0.5 | <0.5 | <0.5 | 0.89 | <0.5 |
| M3S | 11/3/2014 | <0.5 | 3.5 | <0.5 | <0.5 | <0.5 | 1.1 | <0.5 |
| M6S | 11/4/2014 | <0.5 | 2.2 | <0.5 | <0.5 | <0.5 | 0.77 | <0.5 |
| RWMC Production | 10/16/2014 | <0.5 | 6.1 | <0.5 | <0.5 | <0.5 | 3.0 | <0.5 |

[1]Data qualifiers: J = estimate, R = rejected. <DL = 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 physical soil sampling was performed during the fourth calendar quarter of 2014.

## 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 19**. $^{40}$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 19. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2014.**

| Sample Location/Dairy | Sample Date | Naturally occurring Potassium-40 | | Man-made Iodine-131[1] |
|---|---|---|---|---|
| | | Concentration[3] | ± 2 SD | |
| **Monitoring Samples** | | | | |
| Fort Hall | 11/03/2014 | 1492 | 109 | <MDC |
| | 12/02/2014 | 1572 | 112 | <MDC |
| Riverside | 10/06/2014 | 2383 | 138 | <MDC |
| | 11/03/2014 | 2285 | 149 | <MDC |
| | 12/02/2014 | 2642 | 152 | <MDC |
| **Verification Samples[2]** | | | | |
| Howe | 10/07/2014 | 1491 | 108 | <MDC |
| Rupert | 10/07/2014 | 1747 | 107 | <MDC |
| Terreton | 11/04/2014 | 1713 | 121 | <MDC |
| Dietrich | 11/04/2014 | 1761 | 107 | <MDC |
| Idaho Falls | 12/02/2014 | 1742 | 109 | <MDC |
| Rupert | 12/02/2014 | 1683 | 119 | <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 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.

In-Situ gamma spectroscopic measurements were performed at 43 locations (**Figure 4**) during the fourth calendar quarter of 2014. $^{137}$Cs was the only man made gamma emitting radionuclide detected. Analysis results for $^{137}$Cs concentrations for in-situ soil monitoring are shown in **Table 20.**

**Table 20. Gamma spectroscopic analysis results ($^{137}$Cs) for physical soil sampling, fourth quarter 2014.**

| Location | Date Acquired | Concentration[1] | 2-sigma | MDA |
|---|---|---|---|---|
| **Boundary Sampling Locations** | | | | |
| Mud Lake/Terreton Air Station | 11/5/2014 | 0.028 | 0.022 | 0.011 |
| Monteview Air Station | 11/5/2014 | 0.068 | 0.021 | 0.009 |
| Mud Lake Soil Site #2 | 11/5/2014 | 0.106 | 0.025 | 0.011 |
| Monteview Soil Site | 11/5/2014 | 0.137 | 0.022 | 0.009 |
| Large Grid 18-4 | 11/13/2014 | 0.172 | 0.028 | 0.009 |
| Large Grid 12-5 | 11/13/2014 | 0.164 | 0.026 | 0.011 |
| Large Grid 12-4 | 11/13/2014 | 0.171 | 0.026 | 0.010 |
| Big Southern HPIC | 11/13/2014 | 0.201 | 0.026 | 0.010 |
| Frenchman's Cabin | 11/13/2014 | 0.136 | 0.026 | 0.011 |
| Atomic City | 11/17/2014 | 0.189 | 0.033 | 0.008 |
| Reno Ranch | 11/18/2014 | 0.253 | 0.024 | 0.007 |
| Butte City | 11/19/2014 | 0.023 | 0.002 | 0.009 |
| Howe Met Tower | 11/19/2014 | 0.115 | 0.020 | 0.008 |
| **Distant Sampling Locations** | | | | |
| Idaho Falls[2] | 10/28/2014 | 0.066 | 0.021 | 0.009 |
| Idaho Falls CMS[3] | 10/28/2014 | 0.060 | 0.016 | 0.006 |
| St. Anthony | 10/28/2014 | 0.242 | 0.030 | 0.012 |
| Crystal Ice Caves | 10/29/2014 | 0.242 | 0.028 | 0.011 |
| Roberts | 11/5/2014 | 0.179 | 0.025 | 0.010 |
| Sage Junction | 11/18/2014 | 0.205 | 0.025 | 0.012 |
| Carey | 11/19/2014 | 0.167 | 0.027 | 0.011 |
| **On site Sampling Locations** | | | | |
| INT B15 | 10/14/2014 | 1.386 | 0.053 | 0.012 |
| INT B28 | 10/14/2014 | 0.901 | 0.043 | 0.011 |
| INT B29 | 10/14/2014 | 0.681 | 0.038 | 0.010 |
| INT B50 | 10/14/2014 | 1.212 | 0.048 | 0.012 |
| INT B52 | 10/14/2014 | 0.618 | 0.038 | 0.012 |
| INT B40 | 10/14/2014 | 0.737 | 0.040 | 0.011 |
| Large Grid 18-3 | 11/12/2014 | 0.208 | 0.033 | 0.009 |
| Large Grid 18-8 | 11/12/2014 | 0.216 | 0.028 | 0.008 |
| Large Grid 24-2 | 11/12/2014 | 0.209 | 0.029 | 0.010 |
| Large Grid 24-7 | 11/12/2014 | 0.131 | 0.030 | 0.010 |
| Rover | 11/12/2014 | 0.091 | 0.018 | 0.007 |
| Experimental Field Station | 11/17/2014 | 0.176 | 0.025 | 0.010 |
| Large Grid 6-3 | 11/17/2014 | 0.186 | 0.023 | 0.009 |
| INL Main Gate | 11/17/2014 | 0.194 | 0.026 | 0.010 |
| Sand Dunes | 11/18/2014 | 0.154 | 0.024 | 0.015 |
| Large Grid 18-1 | 11/18/2014 | 0.151 | 0.024 | 0.010 |
| Large Grid 18-7 | 11/18/2014 | 0.145 | 0.023 | 0.009 |
| Large Grid 30-1 | 11/18/2014 | 0.201 | 0.024 | 0.009 |
| Large Grid 24-9 | 11/18/2014 | 0.199 | 0.025 | 0.010 |
| Large Grid 24-8 | 11/18/2014 | 0.301 | 0.041 | 0.011 |
| Van Buren | 11/19/2014 | 0.311 | 0.029 | 0.010 |
| Big Lost River Rest Area | 11/19/2014 | 0.172 | 0.022 | 0.008 |
| Base of Howe | 11/19/2014 | 0.165 | 0.024 | 0.010 |

[1]Concentrations are reported in pCi/g.
[2]DEQ-INL OP HPIC air monitoring station near Idaho Falls, ID.
[3]DEQ-INL OP HPIC Community Monitoring Station (CMS) near John's Hole Bridge, Idaho Falls, ID.

The average Cesium-137 value was 0.27 picocuries per gram (pCi/g) with a minimum value of 0.02 pCi/g and a maximum of 1.39 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. All soil monitoring results were consistent with historical measurements. With the exception of the $^{137}Cs$ measurement near the INTEC facility (locations INT B15, B28, B29, B50, B52, and B40) all measurements were in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons. Higher concentrations of $^{137}Cs$ are expected around some site facilities due to past INL operations. While these concentrations exceed fallout levels, they are still well below the DEQ-INL OP action level. In addition, these areas are on-site where access is controlled.

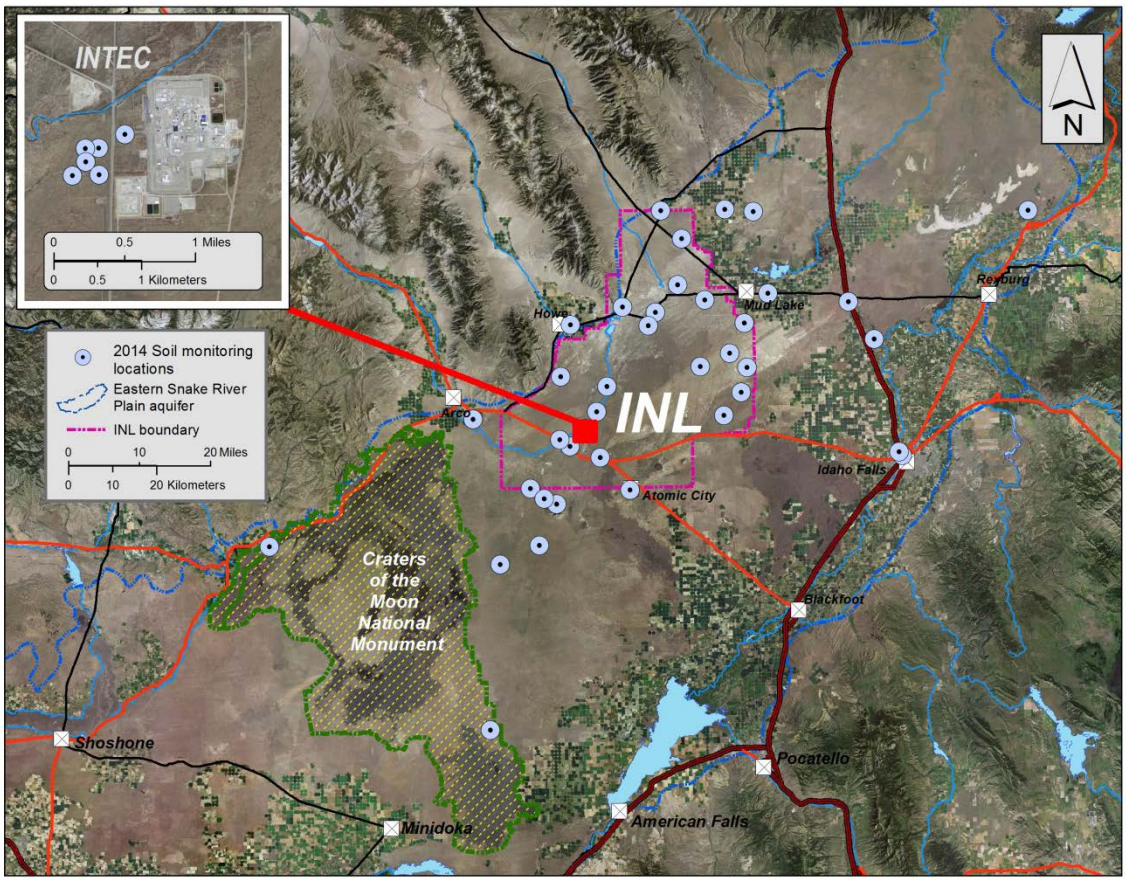


**Figure 4. Physical soil monitoring sites, fourth quarter 2014.**

# 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 fourth quarter of 2014 for the DEQ-INL OP's ESP (Environmental Sampling 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 fourth quarter of 2014, the DEQ-INL OP submitted 100 QC samples for various radiological and non-radiological analyses (**Table 21**).

## 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 fourth quarter of 2014 are presented in **Table 22**.

Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 23**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 24**. Blank analyses results for radiological and non-radiological analytes in ground and surface water are presented in **Table 25**, **Table 26**, **Table 27**, and **Table 28**.

There was one anomaly observed from the assessment of field blank water samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2014. This anomaly included a detection for gross alpha in a blank sample (**Table 26**). Six samples were analyzed along with the blank sample and all results were less than detection for gross alpha and therefore will not be flagged.

## 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 29** for radiological analyses, and **Table 30, Table 31** and **Table 32** for non-radiological analyses. Duplicate results for radiological analyses are presented in **Table 33** for *in-situ* soil analyses.

All duplicate comparisons passed DEQ-INL criteria for the fourth quarter of 2014.

## 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 fourth quarter 2014, no field matrices were spiked to assess the influence of the sample media on laboratory performance; however, several non-radiological spiked samples were created using de-ionized water and submitted to the 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, Table 35** and **Table 36**. Spiked samples for lead failed to achieve recovery limits. Both spiked metal samples were analyzed in the same batch with results for both lead concentrations higher than the spiked values. Lead results for all other samples analyzed with the spikes were non-detect. No lead samples will be flagged. Spiked samples for VOC analyses failed to achieve recovery limits for styrene. The result for styrene was lower than the spiked value. Styrene has never been detected at the site analyzed with the spiked sample and was not detected during this round of sampling. This sample will not be flagged.

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 fourth quarter 2014 are presented in **Table 37**. 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.

There were no other anomalies observed from the assessment of spiked samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2014.

## 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 fourth quarter of 2014, 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 fourth quarter of 2014.

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 fourth quarter of 2014 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 21**.
.

## Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the fourth quarter of 2014 the TSP blower at the Sand Dunes sampling station was replaced. Service reliability for air sampling equipment for the fourth quarter of 2014 is summarized in **Table 38**.

## Conclusion

All data collected for the fourth quarter of 2014 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 21. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, fourth quarter, 2014.**

| Media Sampled | Collection Device | Analyte | Test Analyses | Blank Analyses | Duplicate Analyses | Spike Analyses | Data Rejected[1] | Analyzing Lab[2] |
|---|---|---|---|---|---|---|---|---|
| **Air** | | | | | | | | |
| **Particulate** | 4-inch filter | Gross alpha | 156 | 13 | 0 | 0 | 2 | ISU-EML |
| | | Gross beta | 156 | 13 | 0 | 0 | 2 | ISU-EML |
| | | Gamma emitters | 12 | 1 | 0 | 0 | 0 | ISU-EML |
| | | Radiochemical | 0 | 0 | 0 | 0 | 0 | ISU Sub |
| **Water Vapor** | Desiccant column | Tritium | 28 | 2 | 0 | 0 | 0 | ISU-EML |
| **Gaseous** | Charcoal filter | Iodine-131 | 13 | 0 | 0 | 0 | 0 | ISU-EML |
| **Precipitation** | Poly bottle | Tritium | 6 | 0 | 0 | 0 | 0 | ISU-EML |
| | | Gamma emitters | 6 | 0 | 0 | 0 | 0 | ISU-EML |
| **Water** | | | | | | | | |
| **Groundwater & Surface Water** | Grab or composite | Gross alpha | 29 | 2 | 4 | 0 | 0 | ISU-EML |
| | | Gross beta | 29 | 2 | 4 | 0 | 0 | ISU-EML |
| | | Gamma emitters | 29 | 2 | 4 | 0 | 0 | ISU-EML |
| | | Tritium | 29 | 2 | 4 | 0 | 0 | ISU-EML |
| | | Enriched tritium | 19 | 2 | 1 | 0 | 0 | ISU-EML |
| | | Technetium-99 | 8 | 0 | 2 | 0 | 0 | ISU-EML |
| | | Radiochemical | 17 | 0 | 3 | 0 | 0 | ISU Sub |
| | | Metals | 23 | 1 | 3 | 2 | 0 | IBL |
| | | Common Ions | 23 | 1 | 3 | 2 | 0 | IBL |
| | | Nutrients | 23 | 1 | 3 | 2 | 0 | IBL |
| | | Volatile Organics | 4 | 2 | 1 | 1 | 0 | IBL |
| **Terrestrial** | | | | | | | | |
| **Milk** | Grab or composite | Gamma emitters | 11 | 0 | 0 | 0 | 0 | ISU-EML |
| **Soil** | *in situ* | Gamma emitters | 43 | 0 | 8 | 0 | 0 | DEQ-INL OP |
| | Grab – "puck" | Gamma emitters | 0 | 0 | 0 | 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 Test Analyses** | | | **731** | **44** | **40** | **16** | **4** | |
| **Total of QC Analyses (blanks, duplicates, and spikes)** | | | **100** | | | | | |
| **Percentage of QC analyses of total Test analyses[3]** | | | **13.7%** | | | | | |
| **Percentage of usable data[4]** | | | **99.5%** | | | | | |

[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 22. Blank analysis results for gross alpha and beta in particulate air (TSP), fourth quarter, 2014.**

| Collection Period | | Corrected volume ($m^3$)[1] | Gross alpha | | Gross beta | |
|---|---|---|---|---|---|---|
| Start | Stop | | Value | Uncertainty (± 2 SD) | Value | Uncertainty (± 2 SD) |
| 10/02/14 | 10/09/14 | 2002 | 0.1 | 0.1 | -0.1 | 0.5 |
| 10/09/14 | 10/16/14 | 2002 | 0.0 | 0.1 | -0.1 | 0.5 |
| 10/16/14 | 10/23/14 | 2002 | 0.0 | 0.1 | -0.3 | 0.5 |
| 10/23/14 | 10/30/14 | 2002 | 0.0 | 0.1 | 0.1 | 0.4 |
| 10/30/14 | 11/06/14 | 2002 | -0.1 | 0.1 | -0.2 | 0.5 |
| 11/06/14 | 11/13/14 | 2002 | 0.0 | 0.1 | 0.0 | 0.5 |
| 11/13/14 | 11/20/14 | 2002 | 0.0 | 0.1 | -0.1 | 0.4 |
| 11/20/14 | 11/26/14 | 2002 | 0.1 | 0.1 | 0.3 | 0.5 |
| 11/26/14 | 12/04/14 | 2002 | 0.0 | 0.1 | -0.3 | 0.5 |
| 12/04/14 | 12/11/14 | 2002 | 0.1 | 0.1 | 0.4 | 0.5 |
| 12/11/14 | 12/18/14 | 2002 | 0.2 | 0.1 | 0.1 | 0.5 |
| 12/18/14 | 12/24/14 | 2002 | 0.1 | 0.1 | -0.1 | 0.5 |
| 12/24/14 | 12/31/14 | 2002 | 0.0 | 0.1 | -0.5 | 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 23. Blank analysis results for gamma spectroscopy for TSP particulate air filters, fourth quarter, 2014.**

| Analysis Date | Beryllium-7 | | | Ruthenium-106/Rhodium-106 | | | Antimony-125 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| 01/21/15 | -10 | 28 | 49 | -7 | 34 | 59 | -9 | 11 | 19 |

| Analysis Date | Cesium-134 | | | Cesium-137 | | |
|---|---|---|---|---|---|---|
| | Concentration[1] | ± 2 SD | MDC | Concentration | ± 2 SD | MDC |
| 01/21/15 | 2 | 4 | 7 | 1 | 3 | 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 24. Blank analysis results for tritium in water vapor from air samples, fourth quarter, 2014.**

| Sample Number | Start Date | Collection Date | Analysis Date | Tritium | | |
|---|---|---|---|---|---|---|
| | | | | Concentration | ± 2 SD | MDC |
| OP144ZTR01 | 1/12/15 | 1/13/15 | 1/19/15 | -0.07 | 0.08 | 0.14 |
| OP144ZTR02 | 1/12/15 | 1/13/15 | 1/19/15 | -0.01 | 0.08 | 0.14 |

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

**Table 25. Radiological blank analysis results in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Number | Sample Date | Concentration[1] | ± 2 SD | MDC | Within Blank Criteria? |
|---|---|---|---|---|---|
| **Gross Alpha** | | | | | |
| 141W517 | 10/16/2014 | 0.9 | 0.5 | 0.7 | No |
| 141W536 | 11/20/2014 | 0.3 | 0.4 | 0.6 | Yes |
| **Gross Beta** | | | | | |
| 141W517 | 10/16/2014 | 0.2 | 0.6 | 0.9 | Yes |
| 141W536 | 11/20/2014 | -0.3 | 0.6 | 1.0 | Yes |
| **Cesium-137** | | | | | |
| 141W517 | 10/16/2014 | 1.0 | 2.0 | 3.3 | Yes |
| 141W536 | 11/20/2014 | -0.1 | 1.4 | 2.5 | Yes |
| **Tritium** | | | | | |
| 141W518 | 10/16/2014 | 100 | 110 | 180 | Yes |
| 141W537 | 11/20/2014 | 90 | 110 | 180 | Yes |
| **Enriched Tritium** | | | | | |
| 141W513 | 9/10/2014 | 23 | 8 | 12 | Yes* |
| 141W413 | 8/13/2014 | 34 | 8 | 11 | Yes* |

[1] Concentrations are expressed in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentrations (MDC).
* Note: Reflects typical concentrations found in DI water.

**Table 26. Blank analysis results (µg/L) for metals in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Number | Sample Date | Arsenic | Barium | Chromium | Iron | Lead | Manganese | Selenium | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| 141W520 | 10/16/2014 | <5.0 | <2.0 | <5.0 | <10 | <5.0 | <2.0 | <10 | <5.0 |

**Table 27. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Number | Sample Date | Calcium | Magnesium | Sodium | Potassium | Fluoride | Chloride | Sulfate | Total Alkalinity | Total Nitrogen | Total Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 141W521,520,519 | 10/16/2014 | <0.1 | <0.1 | <0.1 | <0.1 | <0.2 | <0.4 | <0.8 | <1.0 | <0.01 | <0.005 |

**Table 28. Blank analysis results (µg/L) for VOCs in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Number | Sample Date | 1,1-Dichloroethene | Carbon tetrachloride | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Tetrachloroethylene (PERC) | Trichloroethylene | Vinyl chloride |
|---|---|---|---|---|---|---|---|---|
| 141W522 | 10/16/2014 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| 141W541 | 11/4/2014 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |

**Table 29. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, fourth quarter, 2014.**

| 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** | | | | | | | | | |
| M6S | 141W787 | -0.2 | 0.8 | 141W799 | 1.0 | 1.0 | 1.2 | 1.9 | Yes |
| USGS-060 | 141W616 | 1.6 | 1.2 | 141W622 | 1.8 | 1.5 | 0.2 | 2.9 | Yes |
| USGS-115 | 141W667 | 0.8 | 1.0 | 141W674 | -0.2 | 1.1 | 1.0 | 2.2 | Yes |
| Alpheus Spring | 141W810 | 1.1 | 1.2 | 141W812 | -0.6 | 1.4 | 1.7 | 2.8 | Yes |
| **Gross Beta** | | | | | | | | | |
| M6S | 141W787 | 3.7 | 0.9 | 141W799 | 3.1 | 0.9 | 0.6 | 1.9 | Yes |
| USGS-060 | 141W616 | 4.7 | 1.0 | 141W622 | 4.5 | 1.0 | 0.2 | 2.1 | Yes |
| USGS-115 | 141W667 | 8.3 | 1.0 | 141W674 | 7.1 | 1.0 | 1.2 | 2.1 | Yes |
| Alpheus Spring | 141W810 | 6.2 | 1.1 | 141W812 | 7.7 | 1.1 | 1.5 | 2.3 | Yes |
| **Gamma Spectroscopy Cesium-137** | | | | | | | | | |
| M6S | 141W787 | 1.3 | 1.6 | 141W799 | 1.1 | 1.5 | 0.2 | 3.3 | Yes |
| USGS-060 | 141W616 | 0.1 | 1.2 | 141W622 | 0.1 | 1.4 | 0.0 | 2.8 | Yes |
| USGS-115 | 141W667 | 1.1 | 1.8 | 141W674 | 0.8 | 1.4 | 0.3 | 3.4 | Yes |
| Alpheus Spring | 141W810 | 0.5 | 2.5 | 141W812 | 2.1 | 2.7 | 1.6 | 5.5 | Yes |
| **Tritium** | | | | | | | | | |
| M6S | 141W792 | 20 | 110 | 141W804 | 20 | 110 | 0 | 233 | Yes |
| USGS-060 | 141W618 | -10 | 80 | 141W624 | -30 | 80 | 20 | 170 | Yes |
| USGS-115 | 141W670 | 1050 | 130 | 141W677 | 1070 | 130 | 20 | 276 | Yes |
| Alpheus Spring | 141W811 | 90 | 110 | 141W813 | 10 | 110 | 80 | 233 | Yes |
| **Enriched Tritium** | | | | | | | | | |
| MV-27 | 141W371 | 11 | 7 | 141W455 | 17 | 9 | 6 | 17 | Yes |
| **Strontium-90** | | | | | | | | | |
| USGS-060 | 141W617 | 0.47 | 0.34 | 141W623 | -0.07 | 0.29 | 0.54 | 0.67 | Yes |
| USGS-115 | 141W668 | 0.02 | 0.25 | 141W675 | 0.16 | 0.27 | 0.14 | 0.55 | Yes |
| **Technetium-99** | | | | | | | | | |
| M6S | 141W791 | 0.7 | 0.2 | 141W803 | 0.6 | 0.2 | 0.1 | 0.42 | Yes |
| USGS-115 | 141W669 | 7.0 | 0.3 | 141W676 | 6.7 | 0.3 | 0.3 | 0.64 | Yes |
| **Uranium-234** | | | | | | | | | |
| M6S | 141W793 | 1.36 | 0.35 | 141W805 | 1.15 | 0.33 | 0.21 | 0.72 | Yes |
| **Uranium-235** | | | | | | | | | |
| M6S | 141W793 | 0.035 | 0.057 | 141W805 | 0.005 | 0.068 | 0.03 | 0.13 | Yes |
| **Uranium-238** | | | | | | | | | |
| M6S | 141W793 | 0.55 | 0.19 | 141W805 | 0.51 | 0.20 | 0.04 | 0.41 | Yes |

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

**Table 30. Duplicate results for metals (µg/L) in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Location | Sample Number | Sample Date | Arsenic | Barium | Chromium | Iron | Lead | Manganese | Selenium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|
| M6S | 141W795 | 11/4/2014 | <5.0 | 30 | 28 | 30 | <5.0 | 2.9 | <10 | <5.0 |
| M6S | 141W807 | 11/4/2014 | <5.0 | 30 | 28 | 30 | <5.0 | 2.9 | <10 | <5.0 |
| **RPD** | | | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| USGS-060 | 141W620 | 10/20/2014 | 8.4 | 88 | 5.0 | <10 | <5.0 | <2.0 | <10 | <5.0 |
| USGS-060 | 141W626 | 10/20/2014 | 8.6 | 89 | <5.0 | <10 | <5.0 | <2.0 | <10 | <5.0 |
| **RPD** | | | **-2.0** | **-1.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| USGS-115 | 141W672 | 10/7/2014 | <5.0 | 62 | 7.2 | <10 | <5.0 | <2.0 | <10 | 520 |
| USGS-115 | 141W679 | 10/7/2014 | <5.0 | 63 | 6.8 | 10 | <5.0 | <2.0 | <10 | 540 |
| **RPD** | | | **0.0** | **-2.0** | **5.7** | **0.0** | **0.0** | **0.0** | **0.0** | **-4.0** |

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

**Table 31. Duplicate results for common ions and nutrients (mg/L) in groundwater and/or surface water, fourth quarter, 2014.**

| Sample Location | Sample Number | Sample Date | Calcium | Magnesium | Sodium | Potassium | Fluoride | Chloride | Sulfate | Total Alkalinity | Total Nitrogen | Total Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M6S | 141W796,795,794 | 11/4/2014 | 39 | 19 | 16 | 3.4 | 0.243 | 29.6 | 63.5 | 99 | 1.9 | 0.023 |
| M6S | 141W808,807,806 | 11/4/2014 | 38 | 19 | 16 | 3.4 | 0.237 | 29.7 | 63.6 | 97 | 1.9 | 0.023 |
| **RPD** | | | **2.6** | **0.0** | **0.0** | **0.0** | **2.5** | **-0.3** | **-0.2** | **2.0** | **0.0** | **0.0** |
| USGS-060 | 141W621,620,619 | 10/20/2014 | 69 | 18 | 13 | 2.7 | 0.277 | 16.4 | 104 | 150 | 1.4 | 0.15 |
| USGS-060 | 141W627,626,625 | 10/20/2014 | 69 | 18 | 13 | 2.7 | 0.259 | 16.4 | 105 | 150 | 1.4 | 0.15 |
| **RPD** | | | **0.0** | **0.0** | **0.0** | **0.0** | **6.7** | **0.0** | **-1.0** | **0.0** | **0.0** | **0.0** |
| USGS-115 | 141W673,672,671 | 10/7/2014 | 44 | 13 | 16 | 3.9 | 0.321 | 46.5 | 26.1 | 111 | 1.6 | 0.017 |
| USGS-115 | 141W680,679,678 | 10/7/2014 | 44 | 13 | 16 | 3.9 | 0.301 | 42.0 | 25.8 | 108 | 1.6 | 0.013 |
| **RPD** | | | **0.0** | **0.0** | **0.0** | **0.0** | **6.4** | **10.2** | **1.2** | **2.7** | **0.0** | **27.0**[1] |

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

[1]Both results were less than five times the detection limit; their absolute difference is acceptable (≤ the method detection limit of 0.005 mg/L).

**Table 32. Duplicate results for VOCs (µg/L) in groundwater, fourth quarter, 2014.**

| 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 |
| M6S | 11/4/2014 | 141W797 | <0.5 | 2.2 | <0.5 | <0.5 | <0.5 | 0.77 | <0.5 |
| M6S | 11/4/2014 | 141W809 | <0.5 | 2.4 | <0.5 | <0.5 | <0.5 | 0.79 | <0.5 |
| **RPD** | | | **0.0** | **-8.7** | **0.0** | **0.0** | **0.0** | **-2.6** | **0.0** |

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

**Table 33. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2014.**

| Sample Location | Sample Date | Original Result K-40 (pCi/g)[1] | QA Result K-40 (pCi/g)[1] | K-40 RPD (%) | K-40 Less than 3 sigma test | K-40 Meets either criterion? | Original Result Cs-137 (pCi/g)[1] | QA Result Cs-137 (pCi/g)[1] | Cs-137 RPD (%) | Cs-137 Less than 3 sigma test | Cs-137 Meets either criterion? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mud Lake Soil | 11/5/2014 | 21.5 ± 0.8 | 22.7 ± 0.9 | 5.6 | In Spec | Yes | 0.106 ± 0.025 | 0.129 ± 0.026 | 19.6 | In Spec | Yes |
| LG 24-7 | 11/12/2014 | 19.9 ± 0.9 | 19.3 ± 0.9 | 3.1 | In Spec | Yes | 0.131 ± 0.030 | 0.138 ± 0.025 | 5.4 | In Spec | Yes |
| LG 12-4 | 11/13/2014 | 13.0 ± 0.7 | 15.1 ± 0.7 | 14.6 | In Spec | Yes | 0.171 ± 0.026 | 0.208 ± 0.030 | 19.9 | In Spec | Yes |
| LG 12-5 | 11/13/2014 | 13.9 ± 0.7 | 14.6 ± 0.7 | 4.8 | In Spec | Yes | 0.164 ± 0.026 | 0.186 ± 0.027 | 12.2 | In Spec | Yes |
| EFS | 11/17/2014 | 17.5 ± 0.8 | 19.7 ± 0.8 | 11.8 | In Spec | Yes | 0.176 ± 0.025 | 0.147 ± 0.023 | 17.6 | In Spec | Yes |
| LG 24-9 | 11/18/2014 | 20.7 ± 0.9 | 19.3 ± 0.8 | 6.9 | In Spec | Yes | 0.199 ± 0.025 | 0.196 ± 0.025 | 1.6 | In Spec | Yes |
| LG 24-8 | 11/18/2014 | 15.9 ± 0.7 | 16.0 ± 0.7 | 1.0 | In Spec | Yes | 0.301 ± 0.041 | 0.322 ± 0.055 | 6.8 | In Spec | Yes |
| Reno Ranch | 11/18/2014 | 14.6 ± 0.7 | 15.3 ± 0.7 | 4.1 | In Spec | Yes | 0.253 ± 0.024 | 0.259 ± 0.026 | 2.2 | In Spec | Yes |

[1]Result ±2 SD

**Table 34. De-ionized water spike results (in µg/L) and percent recovery for metals in groundwater and/or surface water, fourth quarter, 2014.**

| 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 |
| 141W534 | 10/21/2014 | 52.6 | 57 | **108** | 10.8 | 11 | **102** | 5.59 | 8.4 | **150** | 6.0 | 7.0 | **117** | 21.8 | 22 | **101** |
| 141W524 | 11/3/2014 | 79.3 | 88 | **111** | 13.6 | 14 | **103** | 7.03 | 9.0 | **128** | 7.55 | 8.4 | **111** | 27.4 | 27 | **98** |

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

**Table 35. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, fourth quarter, 2014.**

| 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 |
| 141W534,533 | 10/21/2014 | 16.27 | 16 | **98** | 4.14 | 4.2 | **101** | 8.47 | 8.6 | **102** | 1.70 | 1.7 | **100** | 2.02 | 1.90 | **94** |
| 141W524,523 | 11/3/2014 | 24.5 | 25 | **102** | 6.24 | 6.4 | **103** | 12.8 | 13 | **102** | 2.56 | 2.6 | **102** | 1.90 | 1.80 | **95** |

[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, fourth quarter, 2014.**

| 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 |
| 141W534,533 | 10/21/2014 | 46.5 | 48.9 | **105** | 23.4 | 23.3 | **100** | 81.1 | 81 | **100** | 2.12 | 2.1 | **99** | 0.0119 | 0.010 | **84** |
| 141W524,523 | 11/3/2014 | 79.7 | 78.1 | **98** | 18.1 | 17.7 | **98** | 91.4 | 91 | **100** | 3.34 | 3.4 | **102** | 0.0181 | 0.019 | **105** |

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

**Table 36. De-ionized water spike results (in µg/L) and percent recovery for VOCs in groundwater and/or surface water, fourth quarter, 2014.**

| Spike Sample Number | Sample Date | Carbon Tetrachloride | | | Styrene | | | Tetrachloroethylene | | | Trichloroethylene | | | Vinyl Chloride | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Spike | Result | %R[1] | Spike | Result | %R | Spike | Result | %R | Spike | Result | %R | Spike | Result | %R |
| 141W526 | 11/3/2014 | 3.53 | 2.9 | **82** | 5.28 | 3.2 | **61** | 4.48 | 3.6 | **80** | 5.04 | 5.0 | **99** | 5.4 | 5.2 | **96** |

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

**Table 37. Electret ionization chamber irradiation results (categorized as spiked samples), fourth quarter, 2014.**

| Electret # | Exposure Received | | Net Measured Exposure[1] | | %R |
|---|---|---|---|---|---|
| | (mR) | Uncertainty (±1 SD, mR) | (mR) | Uncertainty (±1 SD, mR) | |
| SGP590 | 40.0 | 2.0 | 34.2 | 1.3 | 85% |
| SGO557 | 40.0 | 2.0 | 38.4 | 1.4 | 96% |
| SGP542 | 40.0 | 2.0 | 35.3. | 1.4 | 88% |
| SGP569 | 29.9 | 1.5 | 26.8 | 1.3 | 90% |
| SGP528 | 29.9 | 1.5 | 26.6 | 1.3 | 89% |
| SGP556 | 29.9 | 1.5 | 26.8 | 1.3 | 90% |
| SGP586 | 20.2 | 1.0 | 17.1 | 1.3 | 85% |
| SGO595 | 20.2 | 1.0 | 19.4 | 1.3 | 96% |
| SGP602 | 20.2 | 1.0 | 18.5 | 1.3 | 92% |

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

[1]Net measured exposure estimate includes a correction for atmospheric pressure.

**Table 38. Air sampling field equipment service reliability (percent operational), fourth quarter, 2014.**

| 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 | 85% | 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, fourth quarter, 2014.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **On-Site Locations** | | | | | | |
| **Big Lost River Rest Area** | 10/02/14 | 10/09/14 | 1.5 | 0.3 | 41.9 | 1.4 |
| | 10/09/14 | 10/16/14 | 0.9 | 0.2 | 29.7 | 1.2 |
| | 10/16/14 | 10/23/14 | 1.1 | 0.2 | 39.6 | 1.3 |
| | 10/23/14 | 10/30/14 | 1.1 | 0.2 | 25.0 | 1.1 |
| | 10/30/14 | 11/06/14 | 1.3 | 0.3 | 31.6 | 1.2 |
| | 11/06/14 | 11/13/14 | 0.9 | 0.2 | 33.2 | 1.3 |
| | 11/13/14 | 11/20/14 | 4.6 | 0.5 | 78.9 | 1.9 |
| | 11/20/14 | 11/26/14 | 1.6 | 0.3 | 42.8 | 1.5 |
| | 11/26/14 | 12/04/14 | 0.8 | 0.2 | 25.3 | 1.1 |
| | 12/04/14 | 12/11/14 | 0.7 | 0.2 | 43.1 | 1.4 |
| | 12/11/14 | 12/18/14 | 1.1 | 0.2 | 31.7 | 1.2 |
| | 12/18/14 | 12/24/14 | 0.6 | 0.2 | 18.2 | 1.1 |
| | 12/24/14 | 12/31/14 | 0.6 | 0.2 | 26.3 | 1.1 |
| **Experimental Field Station** | 10/02/14 | 10/09/14 | 1.5 | 0.3 | 35.6 | 1.3 |
| | 10/09/14 | 10/16/14 | 0.9 | 0.2 | 23.7 | 1.1 |
| | 10/16/14 | 10/23/14 | 1.3 | 0.3 | 32.1 | 1.3 |
| | 10/23/14 | 10/30/14 | 1.1 | 0.2 | 21.1 | 1.1 |
| | 10/30/14 | 11/06/14 | 0.8 | 0.2 | 15.6 | 1.0 |
| | 11/06/14 | 11/13/14 | 0.7 | 0.2 | 28.7 | 1.2 |
| | 11/13/14 | 11/20/14 | 4.9 | 0.5 | 83.3 | 2.0 |
| | 11/20/14 | 11/26/14 | 1.3 | 0.3 | 36.2 | 1.5 |
| | 11/26/14 | 12/04/14 | 0.9 | 0.2 | 22.3 | 1.0 |
| | 12/04/14 | 12/11/14 | 1.2 | 0.3 | 45.6 | 1.5 |
| | 12/11/14 | 12/18/14 | 0.9 | 0.2 | 26.5 | 1.2 |
| | 12/18/14 | 12/24/14 | 0.3 | 0.2 | 16.0 | 1.1 |
| | 12/24/14 | 12/31/14 | 0.5 | 0.2 | 22.1 | 1.1 |
| **Sand Dunes Tower** | 10/02/14 | 10/09/14 | 0.6 | 0.2 | 29.2 | 1.6 |
| | 10/09/14 | 10/16/14 | 0.7 | 0.2 | 19.5 | 1.0 |
| | 10/16/14 | 10/23/14 | 0.9 | 0.2 | 28.2 | 1.1 |
| | 10/23/14 | 10/30/14 | R[1] | R[1] | R[1] | R[1] |
| | 10/30/14 | 11/06/14 | R[1] | R[1] | R[1] | R[1] |
| | 11/06/14 | 11/13/14 | 0.6 | 0.2 | 24.4 | 1.1 |
| | 11/13/14 | 11/20/14 | 3.7 | 0.4 | 60.5 | 1.6 |
| | 11/20/14 | 11/26/14 | 0.9 | 0.3 | 27.8 | 1.2 |
| | 11/26/14 | 12/04/14 | 0.6 | 0.2 | 19.1 | 0.9 |
| | 12/04/14 | 12/11/14 | 0.7 | 0.2 | 30.1 | 1.2 |
| | 12/11/14 | 12/18/14 | 0.9 | 0.2 | 19.0 | 1.0 |
| | 12/18/14 | 12/24/14 | 0.2 | 0.2 | 13.4 | 0.9 |
| | 12/24/14 | 12/31/14 | 0.2 | 0.1 | 17.8 | 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, fourth quarter, 2014.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Van Buren Avenue** | 10/02/14 | 10/09/14 | 1.1 | 0.2 | 28.8 | 1.2 |
| | 10/09/14 | 10/16/14 | 0.9 | 0.2 | 21.4 | 1.0 |
| | 10/16/14 | 10/23/14 | 0.7 | 0.2 | 27.0 | 1.1 |
| | 10/23/14 | 10/30/14 | 0.7 | 0.2 | 17.3 | 0.9 |
| | 10/30/14 | 11/06/14 | 0.9 | 0.2 | 24.5 | 1.1 |
| | 11/06/14 | 11/13/14 | 0.5 | 0.2 | 24.1 | 1.1 |
| | 11/13/14 | 11/20/14 | 3.7 | 0.4 | 65.0 | 1.7 |
| | 11/20/14 | 11/26/14 | 1.0 | 0.3 | 29.1 | 1.3 |
| | 11/26/14 | 12/04/14 | 0.6 | 0.2 | 17.9 | 0.9 |
| | 12/04/14 | 12/11/14 | 0.6 | 0.2 | 36.6 | 1.3 |
| | 12/11/14 | 12/18/14 | 0.8 | 0.2 | 24.0 | 1.1 |
| | 12/18/14 | 12/24/14 | 0.3 | 0.2 | 14.1 | 1.0 |
| | 12/24/14 | 12/31/14 | 0.3 | 0.2 | 19.4 | 1.0 |
| **Boundary Locations** | | | | | | |
| **Atomic City** | 10/02/14 | 10/09/14 | 1.0 | 0.2 | 32.8 | 1.2 |
| | 10/09/14 | 10/16/14 | 0.9 | 0.2 | 22.8 | 1.0 |
| | 10/16/14 | 10/23/14 | 1.2 | 0.2 | 31.4 | 1.2 |
| | 10/23/14 | 10/30/14 | 1.1 | 0.2 | 20.8 | 1.0 |
| | 10/30/14 | 11/06/14 | 0.7 | 0.2 | 25.6 | 1.1 |
| | 11/06/14 | 11/13/14 | 0.8 | 0.2 | 25.7 | 1.1 |
| | 11/13/14 | 11/20/14 | 4.6 | 0.5 | 70.8 | 1.8 |
| | 11/20/14 | 11/26/14 | 1.6 | 0.3 | 37.0 | 1.4 |
| | 11/26/14 | 12/04/14 | 0.8 | 0.2 | 19.4 | 0.9 |
| | 12/04/14 | 12/11/14 | 0.9 | 0.2 | 36.3 | 1.3 |
| | 12/11/14 | 12/18/14 | 0.7 | 0.2 | 24.7 | 1.1 |
| | 12/18/14 | 12/24/14 | 0.4 | 0.2 | 15.3 | 1.0 |
| | 12/24/14 | 12/31/14 | 0.4 | 0.2 | 20.8 | 1.0 |
| **Howe** | 10/02/14 | 10/09/14 | 0.9 | 0.2 | 30.2 | 1.2 |
| | 10/09/14 | 10/16/14 | 0.8 | 0.2 | 21.5 | 1.1 |
| | 10/16/14 | 10/23/14 | 0.6 | 0.2 | 27.6 | 1.2 |
| | 10/23/14 | 10/30/14 | 0.8 | 0.2 | 17.9 | 1.0 |
| | 10/30/14 | 11/06/14 | 0.8 | 0.2 | 24.5 | 1.1 |
| | 11/06/14 | 11/13/14 | 1.0 | 0.3 | 25.5 | 1.1 |
| | 11/13/14 | 11/20/14 | 3.4 | 0.4 | 52.9 | 1.6 |
| | 11/20/14 | 11/26/14 | 1.3 | 0.3 | 31.7 | 1.4 |
| | 11/26/14 | 12/04/14 | 1.0 | 0.3 | 25.2 | 1.4 |
| | 12/04/14 | 12/11/14 | 0.7 | 0.2 | 33.0 | 1.3 |
| | 12/11/14 | 12/18/14 | 0.8 | 0.2 | 24.7 | 1.1 |
| | 12/18/14 | 12/24/14 | 0.4 | 0.2 | 16.6 | 1.1 |
| | 12/24/14 | 12/31/14 | 0.4 | 0.2 | 18.9 | 1.0 |

**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, fourth quarter, 2014.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Monteview** | 10/02/14 | 10/09/14 | 1.3 | 0.2 | 31.6 | 1.2 |
| | 10/09/14 | 10/16/14 | 0.8 | 0.2 | 25.6 | 1.1 |
| | 10/16/14 | 10/23/14 | 1.1 | 0.2 | 29.9 | 1.2 |
| | 10/23/14 | 10/30/14 | 0.8 | 0.2 | 20.1 | 1.0 |
| | 10/30/14 | 11/06/14 | 0.8 | 0.2 | 26.4 | 1.1 |
| | 11/06/14 | 11/13/14 | 0.8 | 0.2 | 26.9 | 1.2 |
| | 11/13/14 | 11/20/14 | 3.8 | 0.4 | 65.4 | 1.7 |
| | 11/20/14 | 11/26/14 | 1.1 | 0.3 | 33.6 | 1.4 |
| | 11/26/14 | 12/04/14 | 1.0 | 0.2 | 24.8 | 1.0 |
| | 12/04/14 | 12/11/14 | 1.0 | 0.2 | 37.3 | 1.3 |
| | 12/11/14 | 12/18/14 | 0.6 | 0.2 | 24.1 | 1.1 |
| | 12/18/14 | 12/24/14 | 0.6 | 0.2 | 17.9 | 1.1 |
| | 12/24/14 | 12/31/14 | 0.5 | 0.2 | 20.5 | 1.0 |
| **Mud Lake** | 10/02/14 | 10/09/14 | 1.9 | 0.3 | 47.2 | 1.4 |
| | 10/09/14 | 10/16/14 | 1.9 | 0.3 | 36.1 | 1.3 |
| | 10/16/14 | 10/23/14 | 2.0 | 0.3 | 47.8 | 1.5 |
| | 10/23/14 | 10/30/14 | 1.3 | 0.3 | 32.1 | 1.2 |
| | 10/30/14 | 11/06/14 | 1.7 | 0.3 | 39.8 | 1.3 |
| | 11/06/14 | 11/13/14 | 1.7 | 0.3 | 42.3 | 1.4 |
| | 11/13/14 | 11/20/14 | 5.0 | 0.5 | 74.7 | 1.8 |
| | 11/20/14 | 11/26/14 | 1.8 | 0.3 | 43.0 | 1.5 |
| | 11/26/14 | 12/04/14 | 1.8 | 0.3 | 34.7 | 1.2 |
| | 12/04/14 | 12/11/14 | 1.8 | 0.3 | 65.6 | 1.7 |
| | 12/11/14 | 12/18/14 | 1.4 | 0.3 | 40.0 | 1.4 |
| | 12/18/14 | 12/24/14 | 0.7 | 0.2 | 23.8 | 1.2 |
| | 12/24/14 | 12/31/14 | 0.8 | 0.2 | 30.0 | 1.2 |
| **Distant Locations** | | | | | | |
| **Craters of the Moon** | 10/02/14 | 10/09/14 | 0.8 | 0.2 | 23.7 | 1.1 |
| | 10/09/14 | 10/16/14 | 0.5 | 0.2 | 18.6 | 1.0 |
| | 10/16/14 | 10/23/14 | 0.7 | 0.2 | 25.2 | 1.1 |
| | 10/23/14 | 10/30/14 | 0.3 | 0.2 | 15.1 | 0.9 |
| | 10/30/14 | 11/06/14 | 0.4 | 0.2 | 18.7 | 1.0 |
| | 11/06/14 | 11/13/14 | 0.6 | 0.3 | 35.6 | 1.6 |
| | 11/13/14 | 11/20/14 | 5.0 | 0.6 | 80.7 | 2.4 |
| | 11/20/14 | 11/26/14 | 1.3 | 0.4 | 35.1 | 1.8 |
| | 11/26/14 | 12/04/14 | 0.6 | 0.2 | 20.8 | 1.2 |
| | 12/04/14 | 12/11/14 | 0.8 | 0.3 | 38.0 | 1.7 |
| | 12/11/14 | 12/18/14 | 1.0 | 0.3 | 32.9 | 1.6 |
| | 12/18/14 | 12/24/14 | 0.2 | 0.2 | 19.0 | 1.4 |
| | 12/24/14 | 12/31/14 | 0.5 | 0.2 | 26.2 | 1.4 |

**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, fourth quarter, 2014.**

| Sample Location | Collection Date | | Gross Alpha | | Gross Beta | |
|---|---|---|---|---|---|---|
| | Start | Stop | Concentration | ±2 SD | Concentration | ±2 SD |
| **Fort Hall**[1] | 10/02/14 | 10/09/14 | 0.7 | 0.2 | 20.6 | 1.0 |
| | 10/09/14 | 10/16/14 | 0.8 | 0.2 | 15.4 | 0.9 |
| | 10/16/14 | 10/23/14 | 0.8 | 0.2 | 24.1 | 1.1 |
| | 10/23/14 | 10/30/14 | 0.7 | 0.2 | 15.7 | 0.9 |
| | 10/30/14 | 11/06/14 | 0.8 | 0.2 | 19.7 | 1.0 |
| | 11/06/14 | 11/13/14 | 0.8 | 0.2 | 19.2 | 1.0 |
| | 11/13/14 | 11/20/14 | 3.0 | 0.4 | 44.4 | 1.4 |
| | 11/20/14 | 11/26/14 | 0.8 | 0.2 | 24.1 | 1.2 |
| | 11/26/14 | 12/04/14 | 0.6 | 0.2 | 13.3 | 0.8 |
| | 12/04/14 | 12/11/14 | 0.5 | 0.2 | 24.8 | 1.1 |
| | 12/11/14 | 12/18/14 | 0.6 | 0.2 | 19.7 | 1.0 |
| | 12/18/14 | 12/24/14 | 0.5 | 0.2 | 12.6 | 1.0 |
| | 12/24/14 | 12/31/14 | 0.3 | 0.2 | 14.2 | 0.9 |
| **Idaho Falls - HVP 3804** | 10/02/14 | 10/09/14 | 1.4 | 0.3 | 36.0 | 1.3 |
| | 10/09/14 | 10/16/14 | 1.3 | 0.3 | 26.7 | 1.2 |
| | 10/16/14 | 10/23/14 | 1.3 | 0.3 | 38.8 | 1.4 |
| | 10/23/14 | 10/30/14 | 1.3 | 0.3 | 24.3 | 1.1 |
| | 10/30/14 | 11/06/14 | 1.0 | 0.2 | 28.8 | 1.2 |
| | 11/06/14 | 11/13/14 | 1.1 | 0.3 | 31.2 | 1.3 |
| | 11/13/14 | 11/20/14 | 3.9 | 0.5 | 67.6 | 1.8 |
| | 11/20/14 | 11/26/14 | 2.4 | 0.5 | 58.5 | 2.3 |
| | 11/26/14 | 12/04/14 | 1.0 | 0.2 | 22.3 | 1.0 |
| | 12/04/14 | 12/11/14 | 0.8 | 0.2 | 36.7 | 1.4 |
| | 12/11/14 | 12/18/14 | 1.1 | 0.2 | 30.6 | 1.3 |
| | 12/18/14 | 12/24/14 | 0.5 | 0.2 | 19.0 | 1.1 |
| | 12/24/14 | 12/31/14 | 0.5 | 0.2 | 23.6 | 1.1 |
| **Idaho Falls - HVP 4304**[2] | 10/02/14 | 10/09/14 | 1.2 | 0.2 | 31.7 | 1.2 |
| | 10/09/14 | 10/16/14 | 1.3 | 0.3 | 21.8 | 1.0 |
| | 10/16/14 | 10/23/14 | 1.5 | 0.3 | 35.1 | 1.3 |
| | 10/23/14 | 10/30/14 | 1.2 | 0.2 | 21.0 | 1.0 |
| | 10/30/14 | 11/06/14 | 1.1 | 0.2 | 25.7 | 1.1 |
| | 11/06/14 | 11/13/14 | 0.9 | 0.2 | 26.9 | 1.1 |
| | 11/13/14 | 11/20/14 | 4.9 | 0.5 | 81.7 | 1.9 |
| | 11/20/14 | 11/26/14 | 2.9 | 0.6 | 61.2 | 2.4 |
| | 11/26/14 | 12/04/14 | 1.2 | 0.2 | 23.7 | 1.0 |
| | 12/04/14 | 12/11/14 | 0.9 | 0.2 | 35.8 | 1.3 |
| | 12/11/14 | 12/18/14 | 0.9 | 0.2 | 29.5 | 1.2 |
| | 12/18/14 | 12/24/14 | 0.6 | 0.2 | 24.3 | 1.2 |
| | 12/24/14 | 12/31/14 | 0.6 | 0.2 | 27.9 | 1.2 |

[1] Operated by Shoshone Bannock-Tribes.

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

# Appendix B

**Table B.1. Results for all electret locations, fourth quarter, 2014.**

| Sample Location | Net Corrected Exposure Rate[1] (µR/hr) | ± 2 SD (µR/h) |
|---|---|---|
| Arco | 11.6 | 0.9 |
| Craters of the Moon | 12.7, 13.7 | |
| Big Lost River Rest Area | 12.7 | 2.8 |
| Van Buren Avenue | 14.5 | 2.5 |
| Experimental Field Station | 13.6 | 3.4 |
| Main Gate | 14.5 | 1.9 |
| Atomic City | 11.6 | 3.1 |
| Taber | 10.3 | 1.3 |
| Blackfoot | 10.3 | 2.9 |
| Ft. Hall [2] | 11.3 | 2.5 |
| Idaho Falls | 12.4 | 3.6 |
| Mud Lake/ Terreton | 12.5 | 1.2 |
| Monteview | 10.2, 11.0 | |
| Sand Dunes | 13.6 | 1.2 |
| Howe Met. Tower | 11.9, 12.9 | |
| MP276 -20 | 9.5 | 3.4 |
| MP274 -20 | 11.1 | 2.9 |
| MP272 -20 | 10.6 | 3.6 |
| MP270 -20 | 10.2, 10.3 | |
| MP268 -20 | 11.7 | 2.2 |
| MP266 -20 | 11.4, 13.4 | |
| MP264 -20 | 12.2 | 1.5 |
| MP270 -20/26 | 12.2 | 2.7 |
| MP268 -20/26 | 13.9 | 2.6 |
| MP266 -20/26 | 14.0 | 3.1 |
| MP263 -20/26 | 12.0 | 2.4 |
| MP261 -20/26 | 9.3 | 0.3 |
| MP259 -20/26 | 15.4 | 2.5 |
| MFC (EBR II) | 11.9, 13.1 | |
| EBR I | ND[3] | ND[3] |
| RWMC | 12.6 | 1.6 |
| CFA | 17.9, 18.8 | |
| CITRC (PBF) | 14.4 | 1.2 |
| INTEC | 14.7, 16.2 | |
| ATR (TRA) | 14.4, 15.3 | |
| NRF | 14.4 | 1.8 |
| TAN/SMC | 14.4 | 1.6 |
| Mud Lake Bank of Commerce | 12.5, 13.8 | |
| MP43-33 | 19.2, 19.6 | |
| MP41-33 | 12.6 | 3.5 |
| MP39-33 | 13.0, 14.1 | |
| MP 37-33 | 10.4 | 1.5 |

**Table B.1 continued. Results for all electret locations, fourth quarter, 2014.**

| Sample Location | Net Corrected Exposure Rate (µR/hr)[1] | ± 2 SD (µR/hr) |
|---|---|---|
| MP35-33 | 9.5 | 3.0 |
| MP33-33 | 13.5 | 0.3 |
| MP31-33 | 11.2, 11.8 | |
| MP29-33 | 11.1 | 1.8 |
| MP27-33 | 12.6, 14.9 | |
| MP25-33 | 12.2 | 3.1 |
| MP23-33 | 10.0 | 2.8 |
| Base of Howe | 15.8,16.4 | |
| Rover | 14.3 | 0.7 |
| Hamer | 10.9, 11.1 | |
| Sugar City | 14.6 | 1.8 |
| Roberts | 12.0 | 2.7 |
| Big Southern Butte | 12.6 | 3.1 |

[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.
[2]Station operated by Shoshone-Bannock Tribes.
[3] No data for this quarter is available. The EIC canister at the EBR 1 location was missing.

# Appendix C

**Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples. Minimum detectable concentrations (MDC) are expressed in µg/L.**

| 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 |
| Tetrachloroethylene (PERC) | 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 | 0.5 |
| 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. Minimum detectable concentrations (MDC) are expressed in µg/L.**

| Analyte | Minimum detectable concentrations (MDC) (expressed in µg/L) |
|---|---|
| 4-Chlorotoluene | 0.5 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 1.0 |
| 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 | 0.5 |
| Hexachlorobutadiene | 0.5 |
| Isopropylbenzene | 0.5 |
| p-Isopropyltoluene | 0.5 |
| Methyl Tert Butyl Ether (MTBE) | 1.0 |
| Naphthalene | 1.0 |
| n-Propylbenzene | 0.5 |
| 1,1,1,2-Tetrachloroethane | 0.5 |
| 1,1,2,2-Tetrachloroethane | 0.5 |
| 1,2,3-Trichlorobenzene | 1.25 |
| Trichlorofluoromethane | 0.5 |
| 1,2,3-Trichloropropane | 0.5 |
| 1,2,4-Trimethylbenzene | 0.5 |
| 1,3,5-Trimethylbenzene | 0.5 |