DEQ-INL
Oversight Program
Annual Report
2018

DEPARTMENT OF ENVIRONMENTAL QUALITY
IDAHO NATIONAL LABORATORY OVERSIGHT PROGRAM

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Table of Acronyms and Abbreviations

aCi/m^3	attocuries per cubic meter
ARP	Accelerated Retrieval Project
AMWTP	Advanced Mixed Waste Treatment Project
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
BHS	Bureau of Homeland Security
CDP	Calcine Disposition Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CH-TRU	Contact-handled transuranic
CRR	Carbon Reduction Reformer
CWI	CH2M-WG Idaho, LLC
CX	Categorical Exclusion
DEQ-INL OP	Department of Environmental Quality, Idaho National Laboratory Oversight Program
DOE	U.S. Department of Energy
EA	Environmental Assessment
EBR II	Experimental Breeder Reactor II
EM	Environmental Management
EIC	electret ionization chamber
EIS	Environmental Impact Statement
EML	Environmental Monitoring Laboratory
EOMA	Environmental Oversight and Monitoring Agreement
EPA	Environmental Protection Agency
ESER	Environmental Surveillance, Education and Research Program
ESP	Environmental Surveillance Program
fCi/m^3	femtocuries per cubic meter
HEPA	High efficiency particulate air filter
HAD	hazard assessment document
HPIC	high-pressure ion chamber
IBHS	Idaho Bureau of Homeland Security
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISFF	Idaho Spent Fuel Facility
ISP	Idaho State Police
ISU	Idaho State University
IWTU	Integrated Waste Treatment Unit
LLD	lower limit of detection
LSC	liquid scintillation counting
MCL	maximum contaminant level
MFC	Materials and Fuels Complex
µg/L	micrograms per liter
µR/hr	microRoentgen per hour
mg/L	milligrams per liter
mrem	millirem or 1/1000th of a rem
mR/hr	milliRoentgen per hour
MDA	minimum detectable activity

MDC	minimum detectable concentration
NCRP	National Council on Radiation Protection and Measurements
NIST	National Institute of Standards and Technology
nCi/L	nanocuries per liter
NE	Nuclear Energy
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
ORPS	Occurrence Reporting and Processing System
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m^3	picocuries per cubic meter
PCE	tetrachloroethylene
QAPP	Quality Assurance Program Plan
QA/QC	quality assurance/quality control
RAP	Radiological Assistance Program
RPD	Relative Percent Difference
RCRA	Resource Conservation and Recovery Act
RH-TRU	remote-handled transuranic
RSWF	Radioactive Scrap and Waste Facility
RTC	Reactor Technology Complex
RWMC	Radioactive Waste Management Complex
SBW	sodium-bearing waste
SD	Standard deviation
SI	International System of Units
SMCL	secondary maximum contaminant level
TAN	Test Area North
TCE	trichloroethylene
TDS	total dissolved solids
TLD	thermoluminescent dosimetry
TMI	Three Mile Island
TRU	transuranic
TSA	Transuranic Storage Area
TSP	total suspended particulate
TSS	total suspended solids
USGS	U.S. Geological Survey
VOC	volatile organic compound
WGA	Western Governors Association
WIPP	Waste Isolation Pilot Plant

SI Prefixes				
Prefix	Symbol	Meaning	Multiplier	Multiplier
			(Numerical)	(Exponential)
tera	T	trillion	1 000 000 000 000	10^{12}
giga	G	billion	1 000 000 000	10^{9}
mega	M	million	1 000 000	10^{6}
kilo	k	thousand	1 000	10^{3}
hecto	h	hundred	100	10^{2}
deka	da	ten	10	10^{1}
deci	d	tenth	0.1	10^{-1}
centi	c	hundredth	0.01	10^{-2}
milli	m	thousandth	0.001	10^{-3}
micro	µ	millionth	0.000 001	10^{-6}
nano	n	billionth	0.000 000 001	10^{-9}
pico	p	trillionth	0.000 000 000 001	10^{-12}
femto	f	quadrillionth	0.000 000 000 000 001	10^{-15}
atto	a	quintillionth	0.000 000 000 000 000 001	10^{-18}

Idaho's INL Oversight Mission

For more than half a century, the Idaho National Laboratory (INL) Site, operated by the Department of Energy (DOE) and its contractors, has been the site of research and development of nuclear technology. The work performed at INL addressed the nation's interests in establishing nuclear reactors as a viable source of energy for civilian and military applications. Beginning in the 1950s, numerous facilities were constructed at INL to study all aspects of the nuclear fuel cycle, including fuel testing, reprocessing, and reactor prototype safety testing. The INL consequently became a site for management of spent reactor fuel (primarily from naval reactors), and radioactive and mixed wastes. Covering almost 900 square miles of the Snake River Plain and located 40 miles west of Idaho Falls, Idaho, the INL was well-suited for these activities. In the late 1980s, environmental management became a major part of the INL's mission. DOE initiated projects to decontaminate and decommission aging facilities, remove waste, and perform environmental cleanup and restoration.

In 1989, the Idaho Legislature established an INL oversight program to provide citizens with independent information and analysis related to the INL Site. In 2007, legislation was enacted to confirm DEQ as the agency responsible for the INL Oversight Program (DEQ-INL OP), which verifies that INL Site activities are protective of public health and the environment. Our staff has expertise in radiation protection, hydrogeology, engineering, ecology, biology, computer science, education, and communications. We serve our fellow Idahoans by:

- Monitoring the environment on and around the INL Site.
- Preparing for emergencies involving radioactive materials.
- Keeping the public informed about INL Site activities.

The purpose of this report is to provide a summary of the activities performed by DEQ during 2018. The report is divided into sections covering the Environmental Surveillance Program (ESP), Radiological Emergency Response Planning and Preparedness, and Public Outreach.

Environmental Surveillance Program

DEQ provides independent environmental monitoring of the INL site for the citizens of Idaho through a multifaceted program of environmental media measurements. Measurements are made at locations on and near the INL Site, including population centers close to the INL Site boundary, and at relatively distant locations in southeast and south central Idaho. DEQ scientists use their data to evaluate public and environmental safety, and to verify monitoring of ambient environmental radiation and radioactivity in air, water, soil, and milk performed by DOE contractors. Currently, DOE funds environmental surveillance through contracts with Veolia, the United States Geological Survey (USGS), Idaho Cleanup Project Core (ICP) contractor (Fluor LLC), and the prime INL contractor, Battelle Energy Alliance, LLC (BEA). Veolia conducts the Environmental Surveillance, Education and Research (ESER) program, which performs environmental surveillance outside the INL site boundary – BEA performs surveillance within the INL site.

In order to present sampling results to the public and interested agencies, DEQ publishes quarterly and annual reports. Each quarterly report contains detailed data and results of the DEQ

environmental monitoring program. Annual reports summarize the quarterly data, identify general trends in the concentrations of major contaminants found in and around the INL Site, assess the impacts of DOE operations on the environment, and evaluate the reliability of DOE-contracted monitoring programs.

Monitoring Results

In 2018, DEQ conducted monitoring to measure environmental radiation levels and radioactivity in air, water, soil, and milk around the INL Site. Radioactivity levels found in air, soil, and milk samples were typical of background values. Tritium in groundwater was detected at a concentration above background in the vicinity of the southern INL boundary. No sites monitored by DEQ exceed federal drinking water standards for tritium. Concentrations of tritium at the INL continue to decline site-wide. No other contaminants attributable to INL Site operations were identified in groundwater samples collected outside of the INL Site.

Environmental measurements made by DEQ within the INL Site in 2018 were consistent with past results. Water samples collected from on-site locations near INL Site facilities identified gross alpha activity, concentrations of ^{90}Sr (strontium-90), chloride, manganese, iron, total nitrate/nitrite (as nitrogen), and some volatile organic compounds (VOCs) greater than drinking water standards. These contaminants were found in known INL contaminant plumes and at levels consistent with historic trends for the sampling locations. These water sources are not used by the public or INL Site workers. Other contaminants from historic INL Site operations were identified in water, but at concentrations less than drinking water standards and within expected levels.

Did You Know?

The amount of radioactivity in the environment is measured using terms that describe how often the material undergoes radioactive decay.

A **curie** is a unit of radioactivity, symbolized as Ci, equal to 3.7×10^{10} disintegrations or nuclear transformations per second. This is approximately the amount of radioactivity emitted by one gram (1g) of radium-226. The unit is named after Pierre Curie, a French physicist.

Fractions of curie are typically used to define small amounts of radioactivity. For example:

milli - millicurie is simply one one-thousandth of a curie
micro - microcurie is simply one one-millionth of a curie
nano - nanocurie is simply one one-billionth of a curie
pico - picocurie is simply one one-trillionth of a curie
femto - femtocurie is one-quadrillionth of a curie
atto - attocurie is one-quintillionth of a curie

Multiplication Factor	Prefix	Symbol
$0.001 = 10^{-3}$	milli	m
$0.000001 = 10^{-6}$	micro	µ
$0.000000001 = 10^{-9}$	nano	n
$0.000000000001 = 10^{-12}$	pico	p
$0.000000000000001 = 10^{-15}$	femto	f
$0.000000000000000001 = 10^{-18}$	atto	a

Tritium was occasionally detected in atmospheric moisture samples collected from both on-site and off-site monitoring locations. When detected these levels were less than one percent of EPA regulatory limits. Environmental measurements of radioactivity in air and direct radiation were typical of background levels at all sites. Radioactivity in the terrestrial environment and food chain remained at background levels, based on soil and milk sampling results.

Trends

Results for 2018 monitoring in terrestrial media and air were generally consistent with historic trends. Radiation levels were consistent with historic background measurements. Concentrations of gross alpha, ^{90}Sr, chloride, manganese, iron, nitrate plus nitrite, and some VOCs exceeded federal drinking water standards at locations on the INL in 2018. Tritium concentration in groundwater continues to decline. Gross beta radioactivity in groundwater at all locations followed trends for ^{90}Sr. The concentrations of some contaminants in groundwater (such as gross alpha radioactivity, ^{99}Tc (technetium-99), and VOCs) showed trends that were not as clearly understood, possibly resulting from changes in INL operations and cleanup efforts. Tritium concentrations in atmospheric moisture remained consistent over time.

Comparison with DOE Data

In general, there is satisfactory agreement between the environmental monitoring data reported by DEQ and the DOE. This level of comparability between DEQ and DOE confirms that both programs present reasonable representations of the state of the environment surrounding the INL. This helps to foster public confidence in both the State's and DOE's monitoring programs and in the conclusions drawn from their monitoring.

In the pages that follow, the results of DEQ's monitoring for each type of media (air, radiation, water, soil, and milk) are discussed in greater detail.

Air Monitoring

Continuous air monitoring is conducted at 11 locations to monitor concentrations of radionuclides in the atmosphere. These 11 locations include one air monitoring station operated by the Shoshone-Bannock Tribes at Fort Hall, Idaho.

Air monitoring locations (and selected other DEQ monitoring sites) are shown in **Figure 1** and continuous air monitoring stations are pictured in **Figures 2 and 3**.

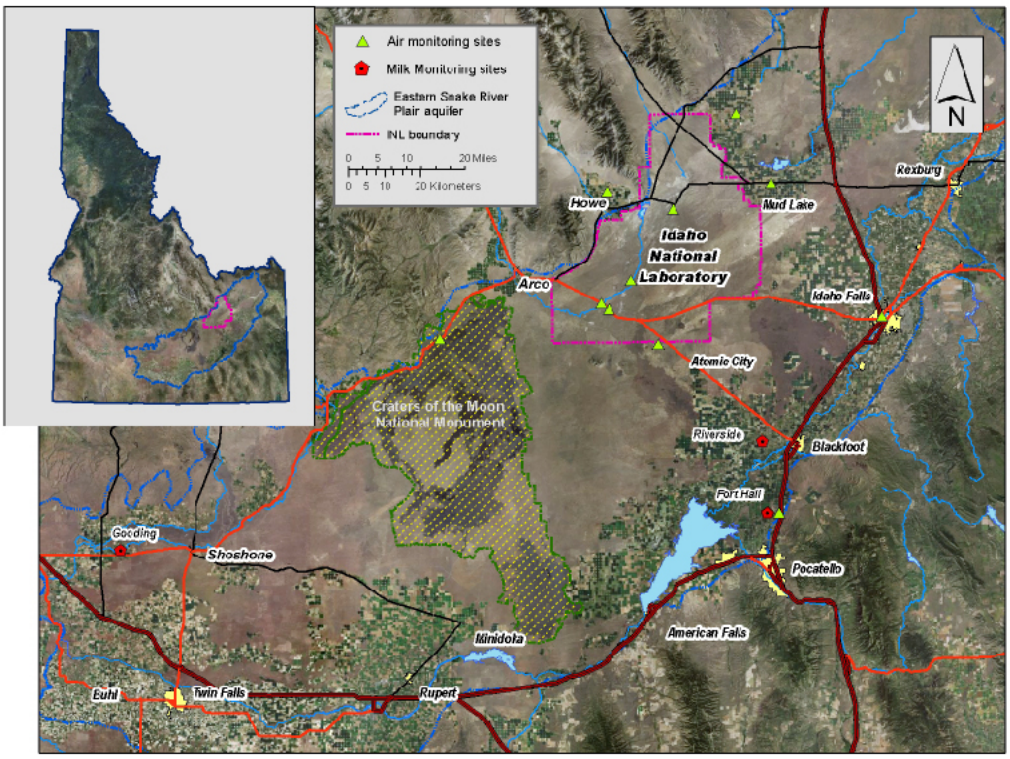

Figure 1. Locations of selected DEQ monitoring sites.

Figure 2. Off-site DEQ continuous air monitoring station.

Air monitoring stations are segregated into three categories by location:

- On-site stations are located within the INL boundary and include Experimental Field Station, Van Buren Avenue, Highway 20 Rest Area, and Sand Dunes/INL Gate 4.
- Off-site stations are located near the INL boundary and include Mud Lake, Monteview, Howe, and Atomic City.
- Distant background stations are located at the Craters of the Moon visitor center, Idaho Falls, and Fort Hall. Measurements at distant locations characterize the regional background conditions for comparison with conditions at on- and off-site stations.

Figure 3. On-site DEQ continuous air monitoring station.

Particulate air samples (filters) and radioactive iodine gas samples (charcoal cartridges) are collected weekly to monitor short-term radiological conditions in the environment. Atmospheric moisture is also collected continuously to measure tritium concentrations present in the air. Finally, precipitation samples are collected at six locations to monitor for tritium and gamma-emitting radionuclides that may be present in the environment. A DEQ air monitoring station with all four types of sampling equipment is pictured in **Figure 4.**

Figure 4. DEQ air monitoring station with a radioiodine sampler, an atmospheric moisture sampler, a precipitation sampler, and two total suspended particulate (TSP) matter samplers.

In order to verify results, data collected by DEQ at some air monitoring stations are directly compared to the air monitoring results obtained by the DOE and its contractors at co-located sample sites.

Air Monitoring Equipment and Procedures

Particulate matter is collected on filters using high-volume total suspended particulate (TSP) matter air samplers. The filters are collected weekly and are analyzed for gross alpha and gross beta radioactivity. Air concentrations are calculated based upon the amount of radioactivity on the filter divided by the volume of air that has passed through the filter. Quarterly composite samples of all TSP filters collected from each location are analyzed for gamma-emitting radionuclides. Yearly composite samples of all TSP filters collected from each location are analyzed via radiochemical separation for ^{90}Sr (strontium-90), ^{241}Am (americium-241), ^{238}Pu (plutonium-238), and $^{239/240}$Pu (plutonium-239/240).

Radioactive iodine (radioiodine) 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 11 air monitoring stations and analyzed together as a group. If radioiodine is detected in this grouping, the canisters are individually analyzed.

Atmospheric moisture is collected by drawing air through a column filled with molecular sieve beads (a desiccant or water-absorbing material). Upon saturation with moisture, the column is removed and the beads are heated, causing them to release their stored moisture. This moisture is then condensed and collected as water in a sample container and subsequently analyzed for tritium.

Precipitation samples are obtained at each location using a collection tray that is heated during the winter months. The sample flows from the tray into a 5-gallon container that is collected at the end of each calendar quarter or whenever it is full. The precipitation samples are analyzed for tritium and for gamma-emitting nuclides.

All samples collected from DEQ's air monitoring program are analyzed by the Idaho State University Environmental Monitoring Laboratory (ISU-EML) or its subcontractor(s). Analysis methods used are consistent with industry standards.

Air Monitoring Results and Trends

The following sections include monitoring results and trends for air monitoring.

Particulate Matter in Air

A total of 584 filters from TSP samplers were collected during 2018. The results from the analyses of off-site location samples were indistinguishable from those of on-site locations. All gross alpha and beta screening results during 2018 were less than the DEQ action levels for prompt response to elevated air screening measurements. Gross alpha/beta results are summarized in **Table 1**.

Table 1. Gross alpha and beta screening ranges and averages observed by DEQ-INL Oversight Program for 2018.

DEQ-INL Oversight Program	Gross Alpha Range (fCi/m^3)[a]	Gross Alpha Average (fCi/m^3)	Gross Beta Range (fCi/m^3)	Gross Beta Average (fCi/m^3)
2018	0.1 to 4.0	1.0 ± 0.1	9.2 to 77.2	27.9 ± 0.6

a. fCi/m^3 – femto (10^{-15}) curies per cubic meter.

Radiochemical analysis of the annual TSP filter composite samples resulted in detection of ^{90}Sr at Atomic City: 18.8 ± 8.2 aCi/m^3 (MDC 13.5 aCi/m^3), Mud Lake: 19.8 ± 8.1 aCi/m^3 (MDC 13.0 aCi/m^3), Craters of the Moon: 14.2 ± 6.6 aCi/m^3 (MDC 10.7 aCi/m^3), and Fort Hall: 19.1 ± 7.3 aCi/m^3 (MDC 11.4 aCi/m^3)[1].

$^{239/240}$Pu was detected at Howe: 4.9 ± 2.6 aCi/m^3 (MDC 2.5 aCi/m^3), Mud Lake: 2.1 ± 1.6 aCi/m^3 (MDC 0.8 aCi/m^3), and Craters of the Moon: 2.9 ± 2.1 aCi/m^3 (MDC 2.7 aCi/m^3).

^{238}Pu was detected at Howe: 7.2 ± 3.8 aCi/m^3 (MDC 4.8 aCi/m^3), Monteview: 5.8 ± 3.9 aCi/m^3 (MDC 5.7 aCi/m^3), Craters of the Moon: 7.9 ± 4.6 aCi/m^3 (MDC 6.3 aCi/m^3), Atomic City: 7.3 ±

[1] An attocurie (aCi) is 10^{-18} curies, or 1/1000th of a femtocurie.

3.8 aCi/m^3 (MDC 4.9 aCi/m^3), Rest Area: 9.9 ± 4.2 aCi/m^3 (MDC 4.7 aCi/m^3), and Idaho Falls: 9.6 ± 4.7 aCi/m^3 (MDC 6.1 aCi/m^3). These values are within the expected range due to global fallout from historic above-ground nuclear weapons testing. The reported concentrations are less than one percent of the federal regulatory limit for ^{90}Sr of 19000 aCi/m^3, $^{239/240}$Pu of 2000 aCi/m^3, and ^{238}Pu of 2100 aCi/m^3 (40 CFR 61).

Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. No manmade gamma-emitting radionuclides were detected by DEQ in the quarterly composites of TSP filters.

Atmospheric Tritium

A total of 119 atmospheric moisture samples were collected in 2018 from 11 monitoring locations and analyzed for tritium. Detectable airborne tritium concentrations are occasionally observed in the environment. The highest airborne tritium concentrations observed by DEQ on the INL in 2018 were 1.25 ± 0.77 pCi/m^3 at the Experimental Field Station for the time period of August 27 through September 25, 1.08 ± 1.28 pCi/m^3 at Van Buren Avenue for the time period of May 24 through June 14, 1.05 ± 1.25 pCi/m^3 at the Big Lost River Rest Area station for the time period of May 10 through May 30, and 0.90 ± 1.04 pCi/m^3 at the Sand Dunes station for the time period of June 11 through June 25.

All atmospheric tritium measurements for 2018 were significantly lower than one percent of the concentration for compliance with federal regulations (40 CFR 61), 1500 pCi/m^3. Tritium levels were at or near background levels at all locations.

Gaseous Radioiodine

No gaseous radioiodine was detected by DEQ in 2018.

Precipitation

No tritium or manmade gamma-emitting radionuclides were detected by DEQ in precipitation samples at any location throughout the year.

Air Monitoring Verification Results

Gross alpha and beta particle results for suspended particulate matter samples from monitoring stations used by DEQ are compared with results from co-located stations operated by the Environmental Surveillance, Education and Research Program (ESER) and by Battelle Energy Alliance (BEA). As a convention, paired sample results are taken to agree if they differ from each other by no more than 20 percent of their average value, or to within 3 times the combined uncertainty of the two measurements. Agreement between 80% of the paired samples is considered to indicate overall statistical agreement of the programs being compared. Another test of agreement is to determine if the conclusions relevant to public health drawn from the results of one program differ from those drawn from the results of another program.

For 2018, over 80% of BEA's gross alpha and beta particle results were in agreement with DEQ's results, indicating overall statistical agreement between DEQ's and BEA's data sets.

(**Table 2**). Comparisons between DEQ and ESER were not in overall statistical agreement. Variations in sampling schedule, equipment configuration and random uncertainty may contribute to observed differences. It is important to recognize that gross alpha and beta particle measurements are a screening method and do not represent quantitative measurement of specific radionuclides.

The results do agree in the important sense that all measurements from the three monitoring organizations are several orders of magnitude below the most restrictive regulatory limit for radionuclides of concern from the INL. The results from all three monitoring agencies indicate that there is no public health risk.

Table 2. Comparison of DEQ suspended particulate matter analysis results for paired samples with ESER and BEA results in 2018.

(Results are presented as percentage of samples that agree within 20 percent or 3 times the combined uncertainty.)

Sampling Agency	ESER Veolia[a]	BEA[b]
DEQ Gross Alpha Analysis	76 %	99%
DEQ Gross Beta Analysis	57 %	80 %

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by INL contractor Veolia.

b. BEA – Battelle Energy Alliance, INL prime contractor during 2018.

Comparing tritium sample results among DEQ, ESER, and BEA is problematic because although sampling sites are co-located, samples are not paired or split samples. Each monitoring agency collects its tritium sample when the desiccant material becomes saturated with moisture; therefore the sampling frequency is dependent on the volume of desiccant used and the sampler flow rate resulting in differences and overlaps in sampling schedules throughout the year. Also, most of the results are near or below the MDC, where statistical uncertainties are relatively high. These factors make a direct one-to-one comparison of results not possible. However, all the results agree in that the maximum measured concentrations are about 3 orders of magnitude below the regulatory limit. Results from all three monitoring agencies indicate no public health risk.

Air Monitoring Impacts and Conclusions

Based upon 2018 air quality measurements, DEQ concludes that there are no discernable impacts to off-site locations as a result of INL operations. The results of screening analyses performed on particulate filters collected at boundary locations are consistent with the results obtained from background locations. A few of the specific radionuclide analyses of composite air samples resulted in statistical detections of human-made radionuclides at concentrations much less than 1% of the federal standard for members of the public (40CFR61).

Atmospheric moisture and precipitation sampling by all three agencies has occasionally shown detectable quantities of tritium in the environment; however, all detected quantities are well below federal regulatory limits and indicate no risk to public health.

Overall, DEQ and DOE contractor air monitoring results are considered to be in agreement based on (1) direct statistical comparison or, (2) because each organization's results support the conclusion that environmental concentrations are well below regulatory limits and pose no health concerns for the citizens of Idaho.

Radiation Monitoring

Penetrating radiation is naturally present in the environment due to cosmic sources, and naturally occurring radioactive materials in rock and soil. Human-made sources include nuclear reactor operations and the residual radioactivity present in soil from historic above-ground testing of nuclear weapons. Radiological conditions on the INL and throughout the eastern Snake River Plain are continuously monitored by DEQ. Penetrating radiation is measured at each of DEQ's air monitoring stations, at meteorological towers maintained by the National Oceanic and Atmospheric Administration (NOAA), along roadways that bound or cross the INL, and at background locations far from the INL (**Figure 6**). Co-located radiation monitoring is conducted by DEQ and DOE contractors at a number of locations. DEQ measurements at these locations are compared with the DOE contractors' results to determine whether the data are in agreement.

Radiation Monitoring Equipment and Procedures

A network of 11 high-pressure ion chambers (HPICs) provides "real-time" monitoring of radiation exposure rates. One of these monitoring stations is owned by the Shoshone-Bannock Tribes at Fort Hall, Idaho. The real-time HPIC measurements are available to the public on the World Wide Web at:

http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx

DEQ also uses a network of passive electret ionization chambers (EICs) on and around the INL to measure cumulative radiation exposure over quarterly monitoring periods. The objectives of the DEQ EIC network are to identify baseline (background radiation) levels to use for comparison in the event of an upset condition (accidental release of radioactive material), assess potential dose in the ambient environment, validate dose assessment models, and to verify contractor environmental radiation data. **Figure 5** shows a DEQ staff member collecting an EIC for analysis and deploying a new one.

Figure 5. Collecting an electret ionization chamber (EIC) and deploying a new one.

Radiation Monitoring Results and Trends

During the course of 2018, EIC and HPIC measurements performed at locations on the INL were similar to those at off-site monitoring locations and were consistent with expected background radiation exposure associated with cosmic, naturally occurring terrestrial and human-made sources.

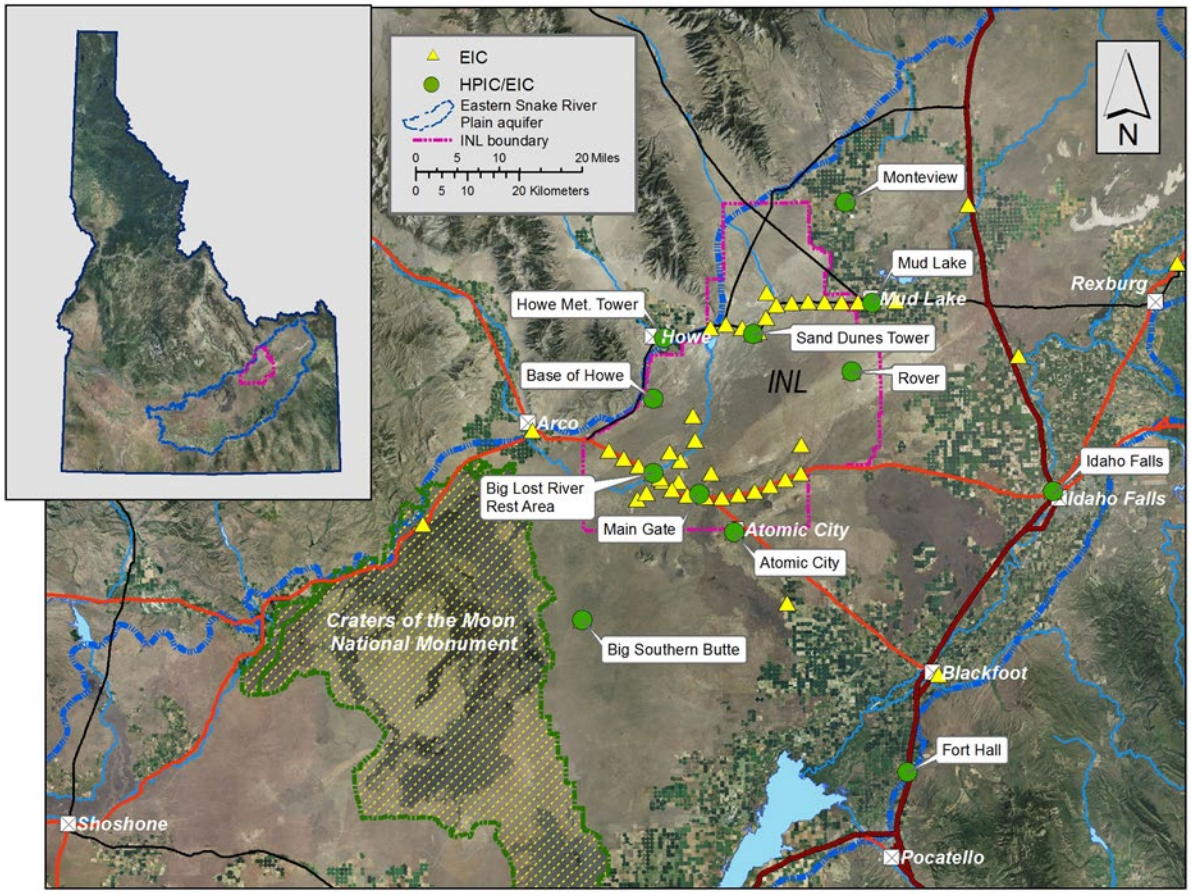

Figure 6. Locations of HPIC and EIC monitoring sites.

Radiation Monitoring Verification Results

DEQ uses EICs at several locations where DOE contractors monitor radiation using optically stimulated luminescent dosimeters (OSLD). Results of the contractors' and DEQ's measurements are used to determine the comparability of the organizations' ambient penetrating radiation measurement programs. During 2018, 82% of BEA's annual average OSLD measurements and 100% of ESER's annual average OSLD measurements were in statistical agreement with DEQ's measurements at co-located EIC sites (**Table 3**), meeting the program's objectives.

Table 3. Comparison of DEQ with ESER, and DEQ with BEA radiation measurements[c] at co-located sites in 2018. (Units in micro-Roentgen per hour or µR/hr)

Statistical Measure	DEQ (µR/hr)	ESER[a] (µR/hr)	DEQ (µR/hr)	BEA[b] (µR/hr)
Mean	13.1	14.2	13.7	16.1
Median	12.9	13.7	13.4	16.4
Standard Deviation	1.4	1.3	1.6	1.2
Minimum	11.0	12.5	11.0	13.9
Maximum	15.4	17.2	16.3	18.2
Average % difference		-8%		-16%

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by INL contractor Veolia.
b. BEA – Battelle Energy Alliance, INL prime contractor during 2018.
c. Each organization's dataset is reviewed to ensure that it supports a valid test of comparability of measurements.

Radiation Monitoring Impacts and Conclusions

Based upon radiation measurements made by DEQ, there were no discernable impacts from INL operations in 2018. Measurements on the INL are comparable to those at background locations. Quarterly averaged HPIC and EIC exposure measurements during 2018 met DEQ's criterion for agreement. The results from all three monitoring agencies indicate no public health risk from environmental ambient penetrating radiation from both natural and human-made sources.

Groundwater Monitoring

DEQ collects groundwater samples from wells and springs located throughout the eastern Snake River Plain aquifer (ESRPA) in order to evaluate the effects of INL contaminants on groundwater quality and verify the results of DOE and USGS monitoring. Each year, DEQ samples approximately 75-85 locations concurrently with a DOE contractor or the USGS and 15 - 20 locations independently. Co-sampled locations are primarily on or near the INL Site and are usually sampled during the second and fourth calendar quarters. DEQ collects samples from most co-sampled locations annually. Independently sampled locations are primarily in the Magic Valley and are typically sampled during the third calendar quarter.

DEQ collects samples from most independently sampled locations every three years, with approximately one-third of the total number of locations being sampled each year. Samples collected from water-monitoring sites are analyzed for radiological and non-radiological constituents, many of which are present in the aquifer both naturally and as a result of INL operations. Analytical results for each sampled location are presented in quarterly monitoring reports available on the DEQ-INL OP website.

Sample Locations

During 2018, DEQ collected water samples from 86 locations within, upgradient of, and downgradient of the INL (**Figures 7 and 8**). Of these, 76 were co-sampled and 16 were sampled independently.[2]

Most water samples are collected each year from aquifer wells or springs formed by the intersection of the aquifer water table with the ground surface. Each aquifer well or spring is categorized as upgradient, facility, boundary, or distant based on its location:

- Upgradient sites are situated north or northeast of INL facilities in areas in which the groundwater has not been affected by INL operations. They are used to monitor background concentrations in the aquifer. In 2018, DEQ sampled five upgradient locations.
- Facility sites are located near facility complexes within the INL, including the Advanced Test Reactor complex (ATR), the Central Facilities Area (CFA), the Idaho Nuclear Technology and Engineering Center (INTEC), the Materials and Fuels Complex (MFC), the Naval Reactors Facility (NRF), the Radioactive Waste Management Complex (RWMC), and Test Area North (TAN). Facility sites are located within or immediately downgradient of known areas of contamination and are sampled to monitor the concentrations and migration of specific contaminants. In 2018, DEQ sampled 33 facility locations.
- Boundary sites are located near the southern boundary of the INL, downgradient of potential sources of INL contamination. In 2018, DEQ sampled 19 boundary locations.[3]
- Distant sites are located farther downgradient of the INL, primarily in the Magic Valley. The distant sites are wells and springs used for agricultural, municipal, domestic, and industrial purposes. In 2018, DEQ sampled 15 distant locations.

A small number of samples are also collected each year from streams, INL-facility wastewater-pond effluent, and wells drilled into perched groundwater (groundwater that sits above the aquifer). In 2018, DEQ sampled three streams, one wastewater pond, and ten perched-groundwater wells.

[2] Six locations—one upgradient and five distant—were sampled both independently and with a co-sampler at separate times during the year.
[3] Each vertical zone in a Westbay well is counted as a unique location (see Methods).

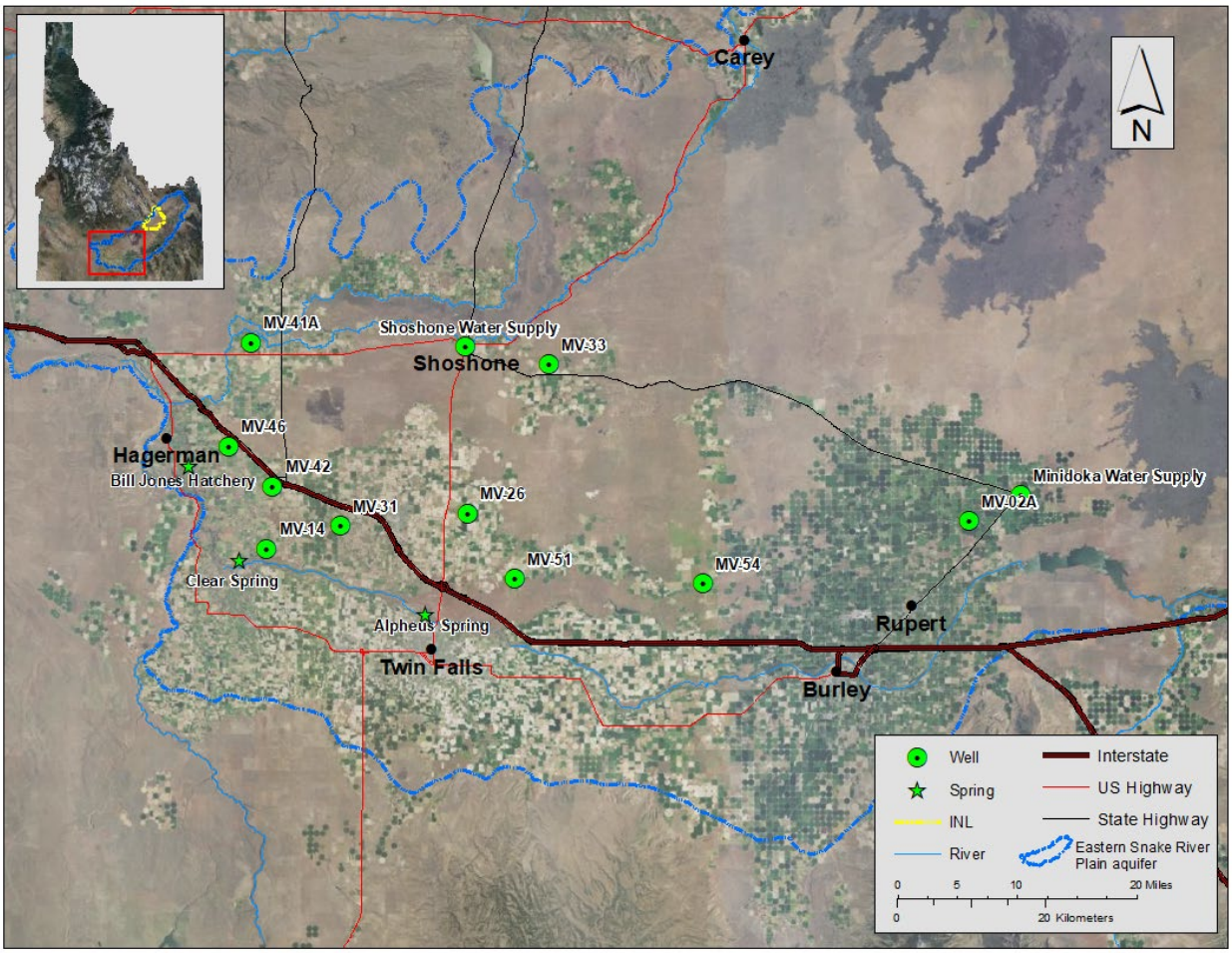

Figure 7. Water quality monitoring sites distant from the INL sampled in 2018.

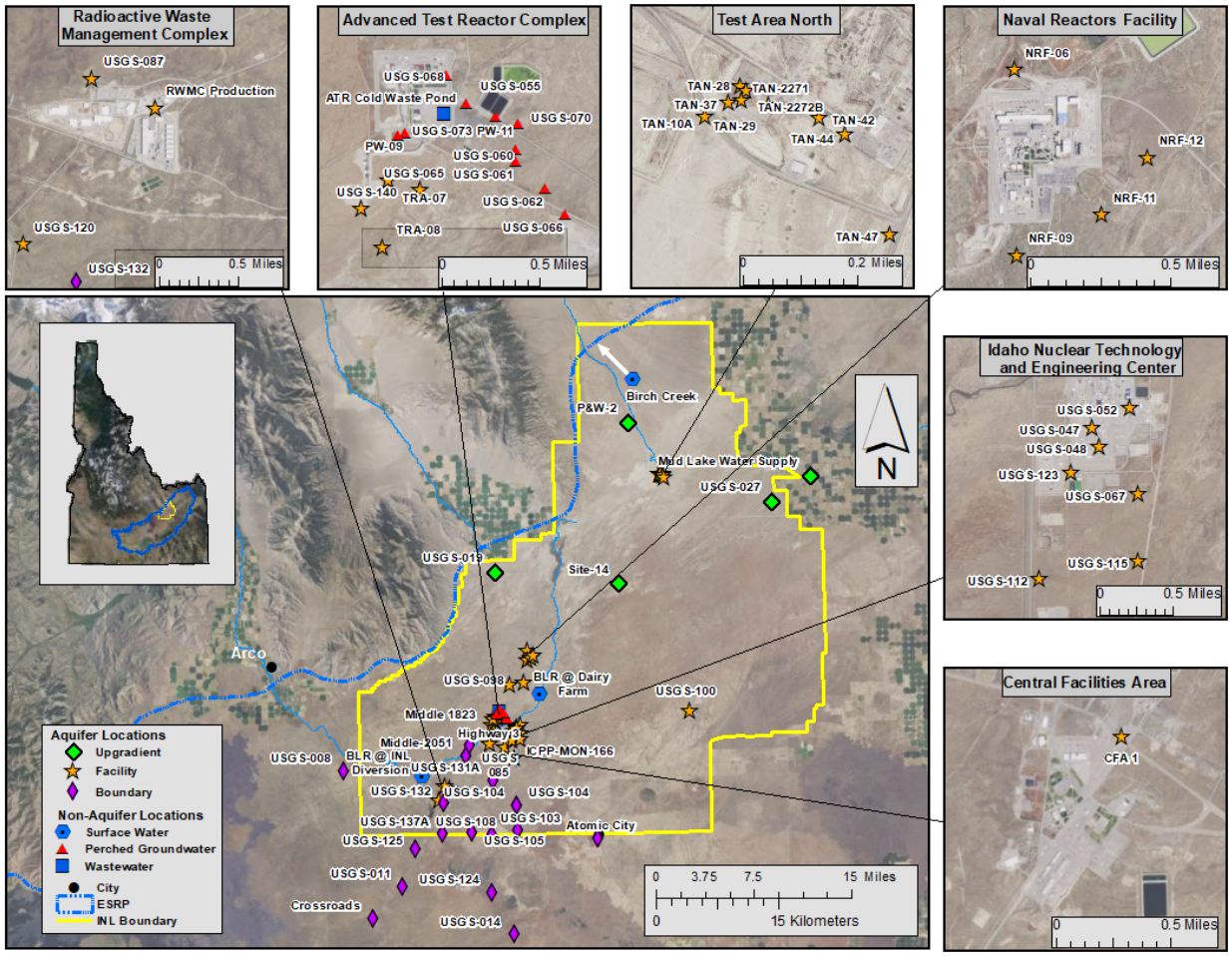

Figure 8. Water quality monitoring sites on and near the INL.

Methods

Most groundwater samples are collected from wells equipped with submersible pumps or vertical turbine pumps. A few wells are sampled using portable pumps that are maintained, deployed, and decontaminated by the co-sampler. Seven boundary wells[4] sampled by DEQ are fitted with Westbay™ multilevel sampling systems ("Westbay wells"). Westbay wells use artificial barriers placed at specific depths to isolate different permeable layers in the aquifer, allowing samples to be collected from multiple depths in the same well.

At locations that DEQ co-samples with the USGS, Fluor, or BEA, including all facility and boundary sites and most upgradient sites, samples are collected in accordance with the co-samplers' procedures and protocols. The co-sampler directs all sampling activities, including well purging (when necessary) and the determination of sample times, and DEQ collects its samples immediately following the co-sampler.

[4] Middle-2051, USGS-103, USGS-105, USGS-108, USGS-131A, USGS-132, USGS-137A.

At locations that DEQ samples independently or with Veolia, including all distant sites and one upgradient site, DEQ conducts sampling activities in accordance with its own procedures and protocols (**Figures 9 and 10**). Wells are purged for a minimum of fifteen minutes, and temperature, pH, specific conductance, and dissolved oxygen are measured every three to five minutes during the purge. The well is sampled once the difference between consecutive readings is within 0.5°C for temperature, 0.1 unit for pH, and 5% for specific conductance for three readings.

DEQ samples all locations for gross alpha and gross beta radioactivity, manmade gamma-emitting nuclides, tritium, common ions,[5] trace metals,[6] nitrate-plus-nitrite, and total phosphorus.[7] Samples from locations at which tritium concentrations are too low to be detected by the standard method are re-analyzed for tritium using an electrolytic enrichment method (referred to as the low-level method), which has a minimum detectable concentration (MDC) about ten times lower than the standard method. Selected sites are also sampled for specific radionuclides—including uranium isotopes (^{234}U, ^{235}U, and ^{238}U), plutonium isotopes (^{238}Pu, $^{239/240}Pu$), americium-241 (^{241}Am), strontium-90 (^{90}Sr), and technetium-99 (^{99}Tc)—and/or volatile organic compounds (VOCs) based on past and present INL operations or a history of elevated concentrations. If unexpected levels of radioactivity are detected in gross measurements, additional samples will be collected and analyzed for specific radionuclides.

Water samples are collected, handled, and preserved using standard DEQ sampling procedures. Trace metals and nutrients samples are filtered, and samples for gross alpha, gross beta, gamma-emitting nuclides, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, ^{90}Sr, trace metals, and nutrients are preserved with acid (HNO_3 and H_2SO_4) immediately after sample collection. VOCs are collected in vials already containing acid (HCl).

Radiological analyses are performed by ISU-EML or its subcontractor(s). Non-radiological analyses are conducted by the Idaho Bureau of Laboratories in Boise. Laboratory methods used for all analyses are consistent with industry standards for drinking-water samples.

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[5] The common ions are calcium, magnesium, potassium, sodium, chloride, fluoride, sulfate, and bicarbonate (reported here as alkalinity).

[6] The trace metals DEQ samples for are arsenic, barium, chromium, iron, lead, manganese, selenium, and zinc.

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

Figure 9. Collecting water samples at a distant well.

Figure 10. Water sampling at a distant well in Magic Valley.

Water Monitoring Results and Trends

A summary of analyte concentrations measured at upgradient, facility, boundary, and distant monitoring sites is presented below. Analytical results from several sample locations with histories of high concentrations are examined more closely to identify current trends. Results for all environmental surveillance samples collected by DEQ are available in quarterly data reports on the DEQ Website http://www.deq.idaho.gov/inl-oversight/monitoring/reports.aspx.

Radiological Analytes

DEQ samples all water monitoring locations for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium. Selected locations are also sampled for specific radionuclides. Concentrations of radiological analytes measured in 2018 were generally consistent with those measured in previous years. Major differences include tritium, gross alpha, and gross beta results which can be attributed to the addition of many facility wells sampled in 2018 that were not sampled in 2017. Results are summarized in **Table 4**. Significant findings for each radiological analyte are discussed below.

Table 4. Summary of analytical results (pCi/L) for radiological constituents in groundwater in 2018. Surface water and wastewater results are excluded.

Analyte	Upgradient			Facility			Boundary			Distant			Background[1]	Drinking Water Standard
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max		
Gross Alpha	<MDC	1.3	2.9 ± 1.0	1.2 ± 1.1	2.2	16.6 ± 3.1	<MDC	1.8	5.0 ± 1.3	<MDC	1.9	3.7 ± 1.4	0-4	15
Gross Beta[2]	1.2 ± 0.8	3.4	7.5 ± 1.1	2.4 ± 1.0	6.3	995.1 ± 23.0	2.0 ± 0.8	3.9	8.0 ± 1.1	<MDC	5.0	8.9 ± 1.2	0-7	---[4]
^{137}Cs	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	0	200[4]
Tritium[3]	<MDC	<MDC	<MDC	<MDC	585	4350 ± 330	<MDC	<MDC	970 ± 190	<MDC	<MDC	<MDC	0-33	20,000[4]
^{234}U	NS	NS	NS	0.15 ± 0.08	1.635	9.4 ± 1.7	NS	NS	NS	NS	NS	NS	0.043-1.9	30 μg/L (total U)
^{235}U	NS	NS	NS	<MDC	<MDC	0.22 ± 0.12	NS	NS	NS	NS	NS	NS	0-0.048	
^{238}U	NS	NS	NS	<MDC	0.77	1.41 ± 0.34	NS	NS	NS	NS	NS	NS	0.021-0.719	
^{238}Pu	NS	NS	NS	<MDC	<MDC	<MDC	NS	NS	NS	NS	NS	NS	0	---
$^{239/240}$Pu	NS	NS	NS	<MDC	<MDC	<MDC	NS	NS	NS	NS	NS	NS	0	---
^{241}Am	NS	NS	NS	<MDC	<MDC	<MDC	NS	NS	NS	NS	NS	NS	0	---
^{90}Sr	NS	NS	NS	<MDC	<MDC	490 ± 120	NS	NS	NS	NS	NS	NS	0	8[4]
^{99}Tc	0.2 ± 0.1	0.9	1.9 ± 0.2	0.9 ± 0.2	2.4	384.0 ± 1.8	NS	NS	NS	NS	NS	NS	0	900[4]

Uncertainties are reported at 2σ. Abbreviations: pCi/L, picocuries per liter; MDC, minimum detectable concentration, NS, not sampled.

[1] Background levels for gross alpha, gross beta, and ^{137}Cs are derived from over 20 years of DEQ groundwater monitoring in the ESRP aquifer. Background levels for ^{3}H are taken from a five-year average plus two standard deviations of DEQ data from distant and upgradient locations. Uranium isotopes, plutonium isotopes, ^{90}Sr, and ^{99}Tc are based on Bartholomay and Hall (2016; DOE/ID 22237). Background concentrations depend on local geology and proximity to surface water recharge locations. Concentrations for sites not influenced by INL activities may still be higher than the given background ranges.

[2] Gross beta as ^{137}Cs.

[3] Results for tritium are from the standard analysis method, with an MDC of approximately 130 pCi/L.

[4] The federal drinking water standard is expressed as a cumulative annual dose of 4 millirem/year. This value was converted to a specific concentration (pCi/L) for each analyte.

Gross Alpha and Gross Beta Radioactivity

Radionuclide contributors of alpha and beta activity are present in the aquifer naturally and as a result of past INL operations. Gross alpha and gross beta analyses measure radioactivity contributed by all alpha and beta emitters in a water sample (excluding radon and tritium). These analyses are used for screening purposes only and do not yield quantitative measurements of specific radionuclides.

The primary natural sources of alpha radioactivity in groundwater and surface water are uranium and thorium, and the primary natural sources of beta radioactivity are potassium-40 and beta-emitting daughter products of naturally occurring uranium and thorium. All of these nuclides are present in the bedrock and sediments of the eastern Snake River Plain at low concentrations, and their presence in groundwater contributes to a low but measureable level of radioactivity in the aquifer, defined as background. Background concentrations of gross alpha and gross beta radioactivity, derived from over 20 years of DEQ data collected from ESRPA locations not affected by INL activities, are given as ranges in **Table 4**.

Gross alpha levels observed at most locations in 2018 were within the background range defined by DEQ and can be attributed to natural sources. Levels above background were measured in the aquifer and at surface water locations within the INL site, NRF, TAN, and in perched groundwater at ATR. The highest gross alpha concentration measured was 16.6 ± 3.1 pCi/L at TAN-28. This is the only well to exceed the EPA maximum contaminant level (MCL) of 15 pCi/L.

Gross beta levels exceeded background at several facility locations. Many exceedances were at TAN, where the highest concentration was 995.1 ± 23.0 pCi/L at TAN-2272B and at INTEC, where the highest concentration was 207.4 ± 3.4 pCi/L at USGS-052. The high level of gross beta activity at TAN is due to a high ^{90}Sr concentration, discussed below. The MCL for beta activity is 4 mrem/year, which is equivalent to 8 pCi/L if the source is ^{90}Sr, 900 pCi/L if ^{99}Tc, and 20,000 pCi/L if tritium.

Gamma-emitting radionuclides

The only gamma-emitting radionuclide reported in 2018 is cesium-137. ^{137}Cs has historically been detected at low concentrations at TAN and INTEC. In 2018, ^{137}Cs was not detected at concentrations exceeding the MDC.

Tritium (^{3}H)

Tritium in ESRPA groundwater comes from natural sources, twentieth-century nuclear weapons tests, and past INL waste disposal practices. Natural tritium, produced primarily by the interaction of atmospheric nitrogen with cosmic rays, and tritium from weapons tests are incorporated in groundwater through surface recharge, resulting in a low background concentration of tritium in young groundwater that decreases with residence time in the aquifer. Groundwater locations close to areas of surface recharge may have background tritium concentrations that are higher than the given background range, whereas groundwater locations

that are distant from surface recharge, such as near the center of the eastern Snake River Plain, are more likely to have background tritium concentrations near zero. As surface-water concentrations of tritium from weapons tests decrease over time due to radioactive decay, the upper end of the background range decreases. The range of background concentrations of tritium typically observed in the ESRPA is given in **Table 4**.

Tritium was introduced to the aquifer at concentrations well above the background range by past INL waste disposal practices, including the use of wastewater injection wells and percolation ponds at ATR, INTEC, and TAN (DOE/ID-22242). Tritium concentrations once exceeded the MCL of 20,000 pCi/L at some wells in these areas; however, over the past two decades, concentrations have declined significantly due to radioactive decay and dilution.

In 2018, elevated tritium concentrations were measured in facility wells at ATR, INTEC, TAN, CFA, and RWMC, consistent with previous years. The highest concentration measured in the aquifer at each of these facility complexes was:

- ATR → 4350 ± 330 pCi/L at TRA-07
- CFA → 2610 ± 270 pCi/L at CFA-1
- INTEC → 1990 ± 240 pCi/L at USGS-123
- TAN → 1120 ± 200 pCi/L at TAN-29
- RWMC → 540 ± 170 pCi/L at USGS-087

Tritium was also detected well above background levels in perched groundwater at ATR, with a maximum concentration of 9670 ± 470 pCi/L at USGS-055. **Figure 11** shows tritium trends for selected wells at ATR, INTEC, and RWMC. Overall, tritium concentrations in facility wells in 2018 were consistent with previous years and continue to decline gradually.

Tritium was detected above background concentrations in the vicinity of the southern INL boundary. The highest tritium concentration for boundary wells was 970 ± 190 pCi/L at well USGS-131A at 812 ft below land surface.

Figure 12 shows a concentration map of tritium measurements in and around the INL in 2018. No elevated tritium measurements were detected at distant sites in 2018.

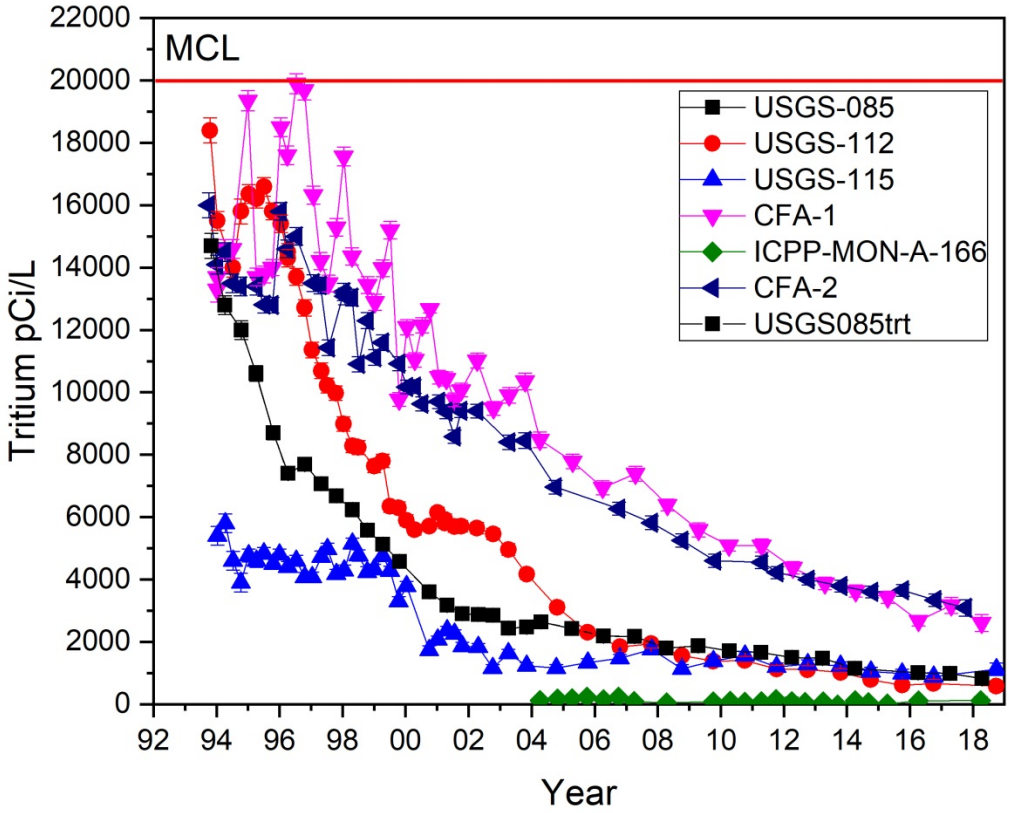

Figure 11. Tritium concentrations (pCi/L) over time for selected facility wells.

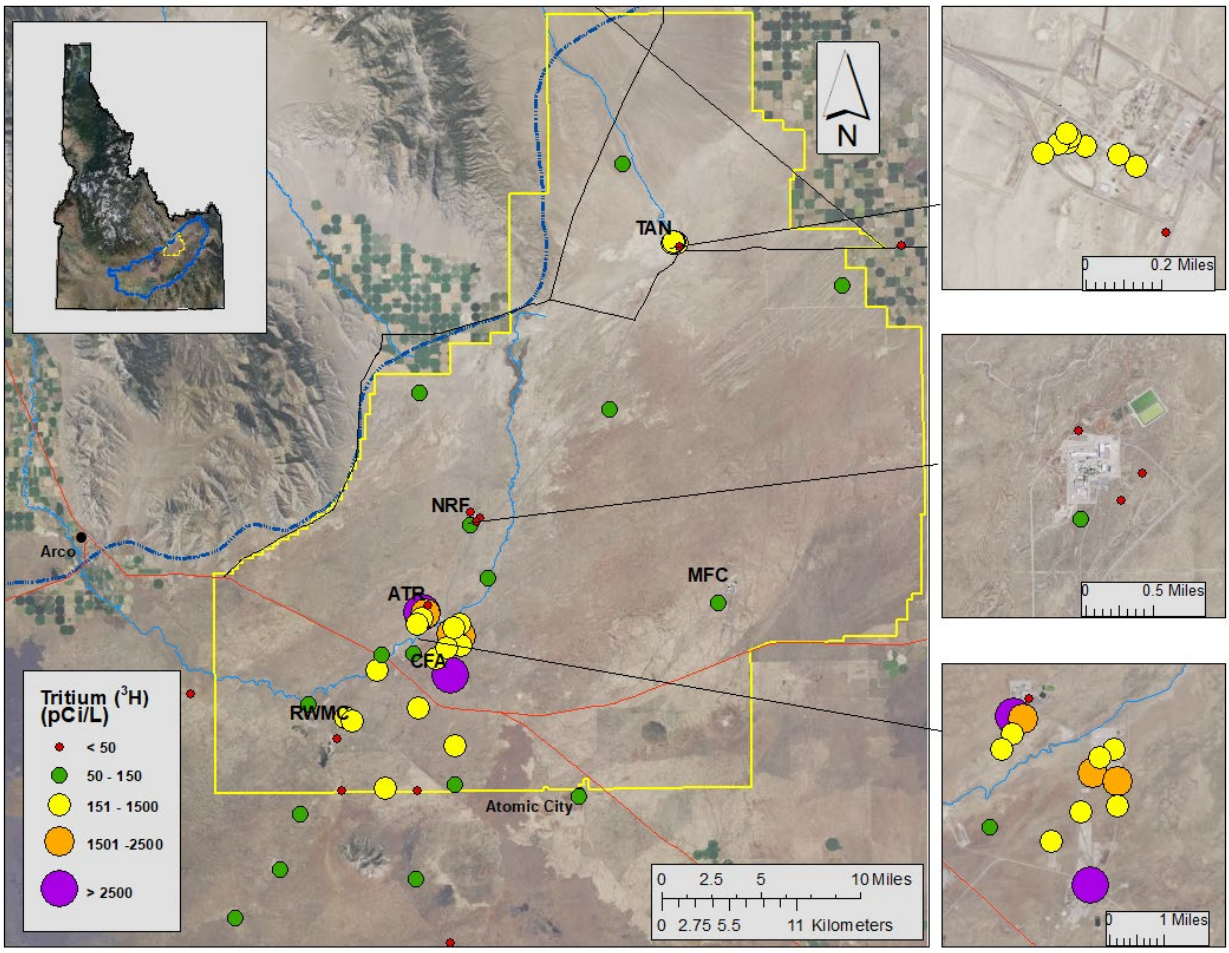

Figure 12. Tritium concentrations for DEQ sample locations in 2018 in and around the INL.

Locations with tritium concentrations reported as below the minimum detectable concentration (MDC) are plotted based on the value of the MDC (e.g., a location whose tritium concentration is reported as <100 pCi/L will be plotted as a green circle).

Uranium and Transuranic Isotopes

Selected locations at TAN, ATR, and INTEC were sampled for ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239/240}$Pu and ^{241}Am in 2018. ^{238}Pu, $^{239/240}$Pu, and ^{241}Am were not detected at any location. ^{234}U, ^{235}U, and ^{238}U were detected in the aquifer at concentrations above background in 13 wells: four at INTEC, six at TAN and three at ATR. The highest concentrations of all three uranium isotopes were found at TAN-28 (see maximum concentrations in **Table 4**). Elevated uranium concentrations in the groundwater at TAN, ATR, and INTEC have been previously identified and are attributed to past waste disposal practices.

Strontium-90 (^{90}Sr)

^{90}Sr is one of the two main sources of above-background levels of gross beta radioactivity (the other is ^{99}Tc, discussed in the next section). Past waste disposal practices and spills have resulted in elevated concentrations of ^{90}Sr in the aquifer at TAN and INTEC and in perched groundwater at INTEC and ATR.[8] Concentrations of ^{90}Sr above the MCL of 8 pCi/L are typically measured in wells at each of these facility complexes.

In 2018, the highest ^{90}Sr concentrations continue to be measured at and near TAN, with a maximum concentration of 490 ± 120 pCi/L at TAN-37A. ^{90}Sr concentrations over time for all TAN wells sampled by DEQ are shown in **Figure 13**. The concentration of ^{90}Sr in the groundwater at TAN is directly affected by in situ bioremediation (ISB) treatment of the TAN TCE plume (see discussion in the "Volatile Organic Compounds" below). Injections of whey and sodium lactate into the aquifer from 1999 to 2012 increased calcium and magnesium concentrations in the groundwater, resulting in increased competition for adsorption sites on aquifer minerals and consequent displacement of strontium cations into the groundwater. Injections were stopped in 2012 to allow redox conditions in the aquifer to return to their pre-treatment state. ^{90}Sr concentrations decreased, presumably, as added calcium and magnesium cations diffused and dispersed (see **Figure 13**). In January 2016, injections of an oil-based amendment were started at TAN-2272 to treat a residual TCE source in the vicinity of TAN-28 (downgradient of TAN-2272). In April of 2018, injections moved to TAN-37 and ^{90}Sr concentrations at nearby well TAN-37A are approaching pre-2012 levels.

^{90}Sr concentrations above the MCL were also measured in the aquifer at INTEC and in perched groundwater at ATR. **Figure 14** shows ^{90}Sr concentrations over time for aquifer wells at INTEC (USGS-047, USGS-067, ICPP-2020, USGS-085, and USGS-112) and a perched groundwater well at ATR (USGS-055). The highest concentration measured in the aquifer at INTEC was 16.2 ± 3.9 pCi/L at USGS-047. The highest concentration measured in perched groundwater at ATR was 22.7 ± 5.5 pCi/L at USGS-055. No ^{90}Sr was detected in the aquifer at ATR. All concentrations measured in 2018 were consistent with previous years.

A concentration map of all INL locations sampled for ^{90}Sr in 2018 is shown in **Figure 15**.

[8] The Idaho Cleanup Project contractor has detected high concentrations of ^{90}Sr in perched groundwater overlying the aquifer at INTEC. DEQ does not currently sample perched groundwater at INTEC.

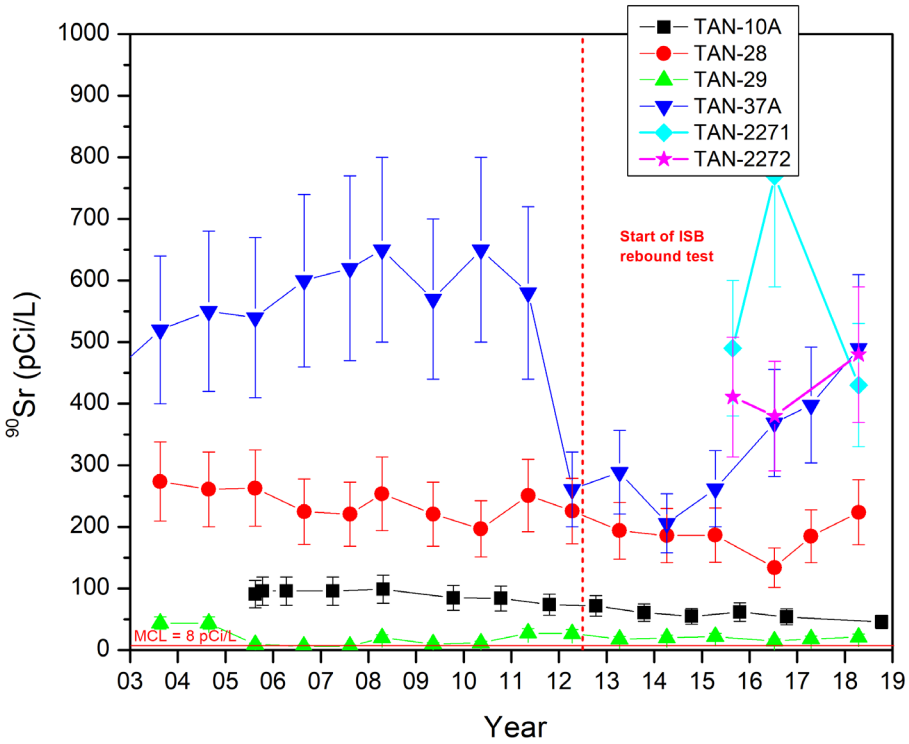

Figure 13. Strontium-90 concentrations over time for selected wells at TAN.

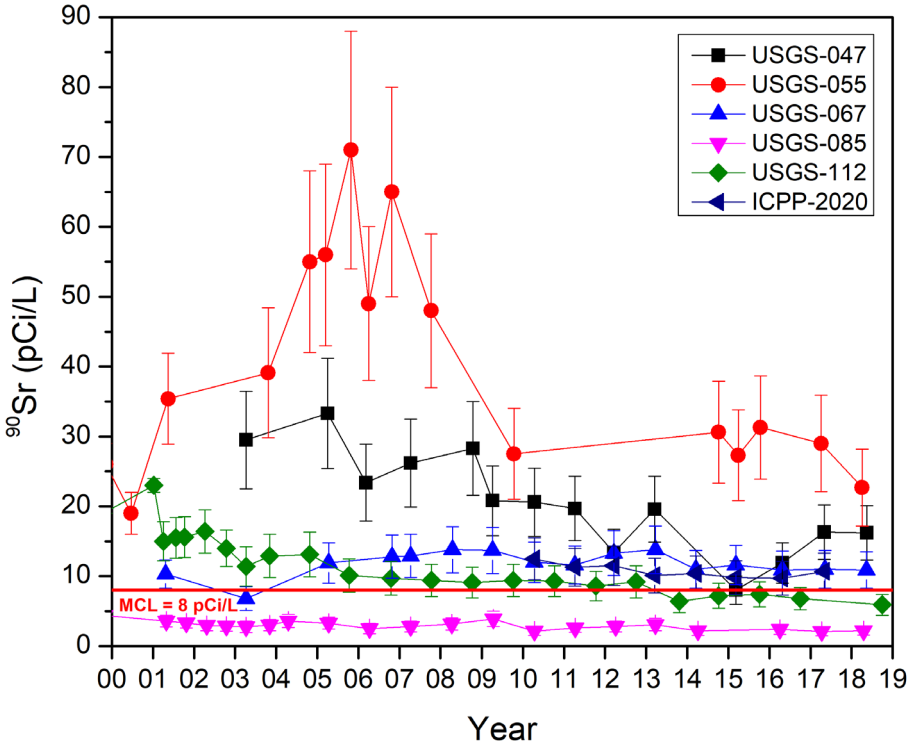

Figure 14. Strontium-90 concentrations over time for selected wells at INTEC and ATR.

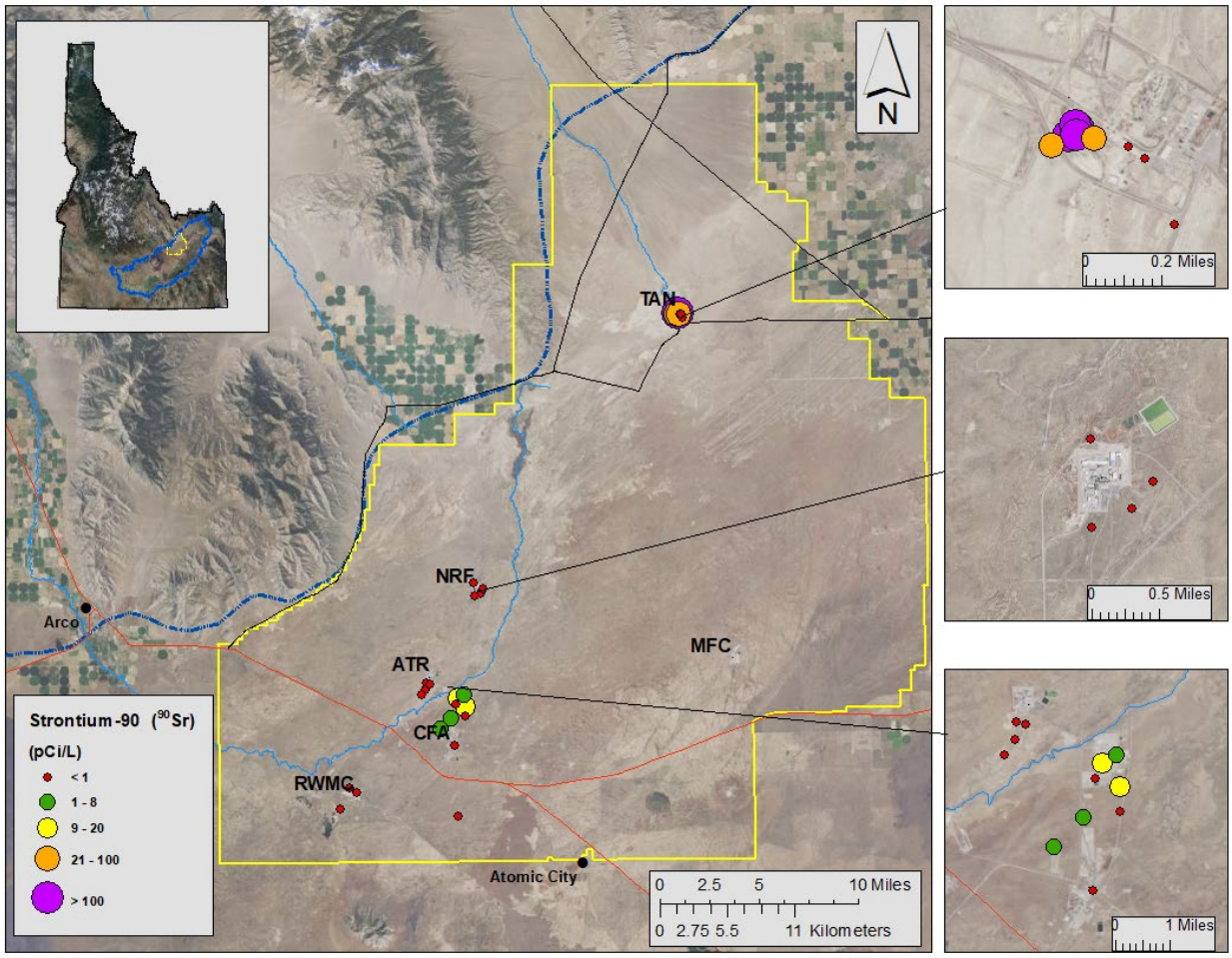

Figure 15. Aquifer strontium-90 concentrations for DEQ sample locations in 2018 in and around the INL.

Technetium-99 (^{99}Tc)

^{99}Tc has been introduced to the aquifer by leaks and spills at INTEC, including the inadvertent release of 18,600 gallons of sodium-bearing waste during a transfer between underground storage tanks at INTEC in 1972. **Figure 16** shows ^{99}Tc concentrations over time for selected INL wells located at or downgradient of INTEC. In 2018, all ^{99}Tc detections remained well below the MCL of 900 pCi/L. The highest concentrations measured by DEQ in 2018 continue to be at USGS-052 (384 ± 1.8 pCi/L) and USGS-067 (101.6 ± 0.9 pCi/L). All other ^{99}Tc detections in 2018 were below 20 pCi/L and were consistent with measurements in previous years.

Figure 17 shows a concentration map of all INL ^{99}Tc sample locations in 2018.

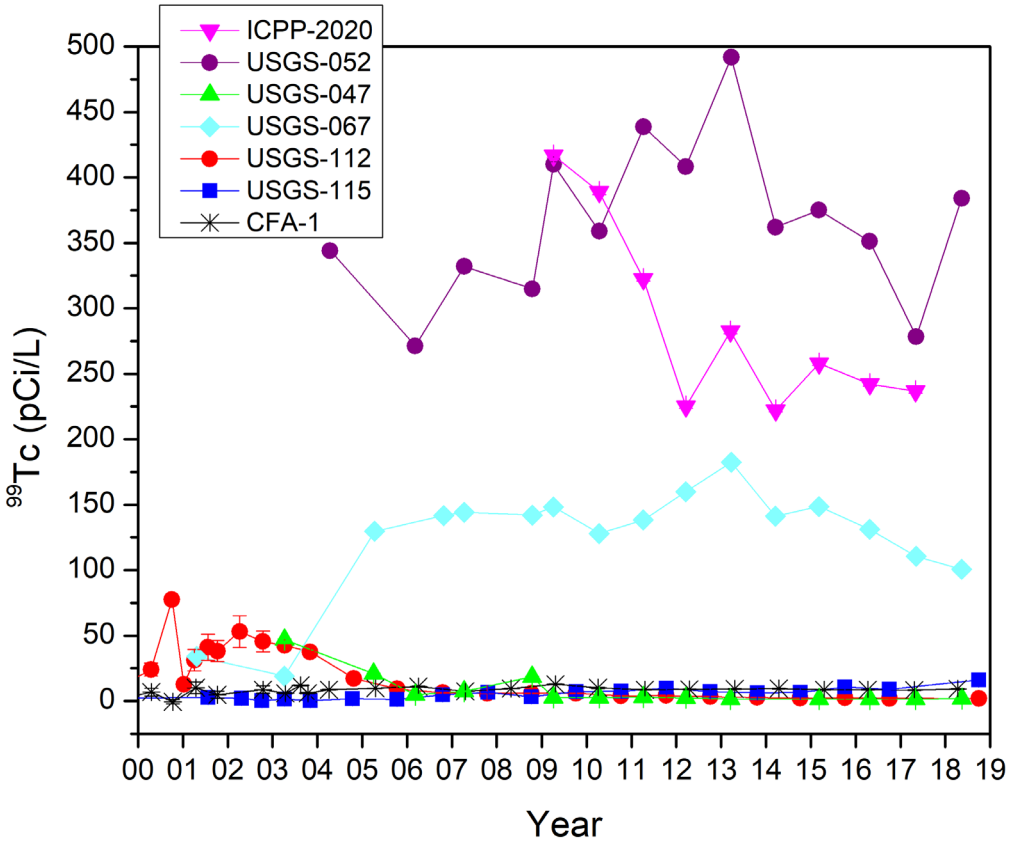

Figure 16. Technetium-99 concentrations over time for selected wells at or downgradient of INTEC.

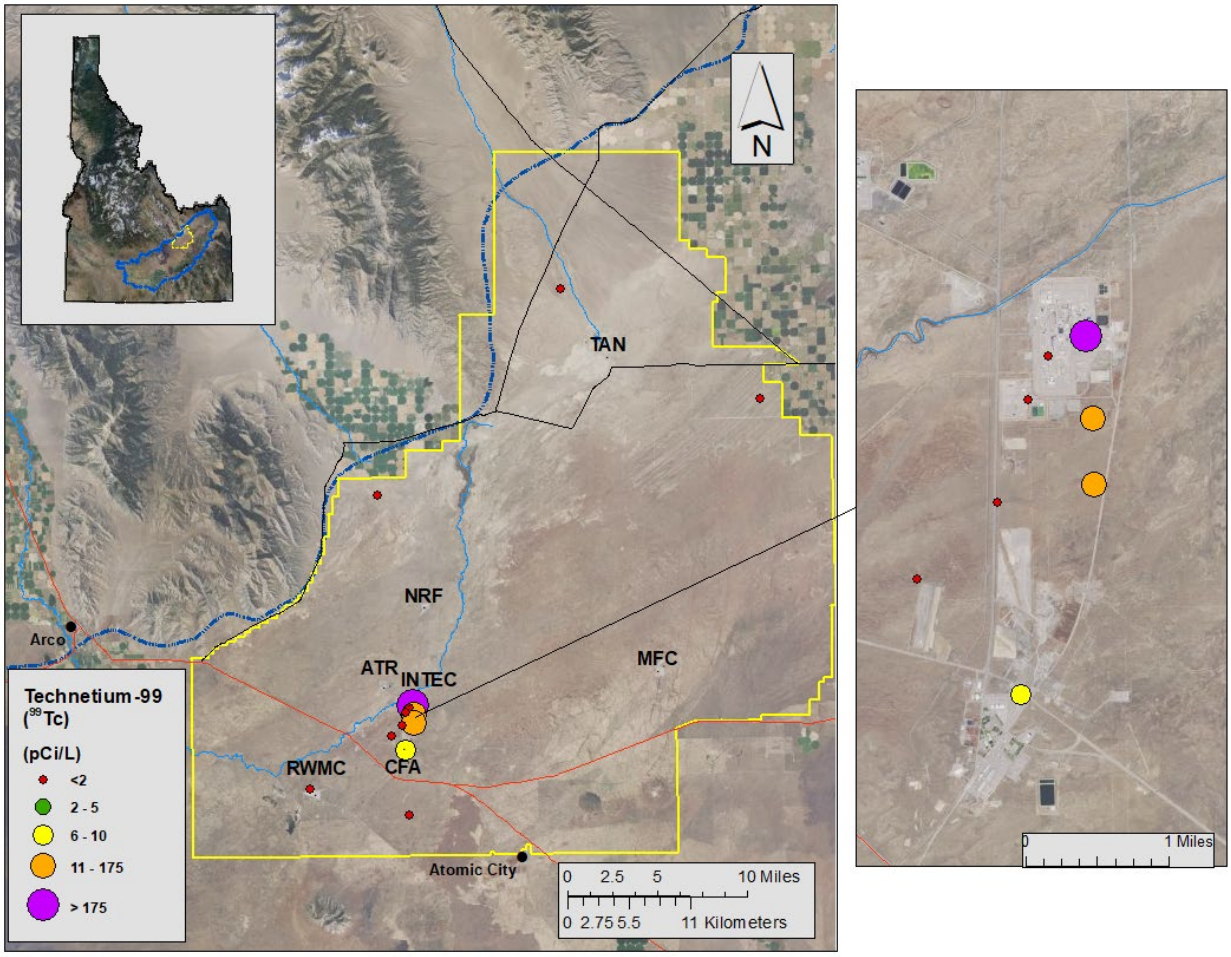

Figure 17. Technetium-99 concentrations for DEQ sample locations in 2018.

Non-radiological Analytes

DEQ samples all water monitoring locations for common ions, nutrients, and trace metals. Selected locations are also sampled for VOCs. Elevated concentrations of these constituents are present in the groundwater at some locations as a result of past INL waste disposal practices.

Concentrations of non-radiological analytes measured in 2018 were generally consistent with those measured in previous years. Major differences are resultant of the addition of wells to the program in 2018 that were not sampled previously. Results are summarized in **Table 5**. Analytes that exceeded drinking water standards in 2018 or in the recent past, which include chloride, nitrate plus nitrite, chromium, manganese, iron, and certain VOCs, are discussed in greater detail below.

Table 5. Summary of analytical results for non-radiological constituents in groundwater in 2018. Surface water and wastewater results are excluded.

Analyte	Upgradient			Facility			Boundary			Distant			Background[1]	Drinking Water Standard[2]
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max		
Common Ions (mg/L)														
Alkalinity (as $CaCO_3$)	93	145	159	107	151	1980	120	142	157	122	164	224	91-261[a]	none
Calcium	8.9	41	52	30	54	130	29	40	51	25	45	73	23 – 71[a]	none
Chloride	4.68	9.77	47.4	10.7	28	415	6	13.3	21	6.73	32.2	68.4	4.9 – 66.6[a]	250*
Fluoride	<DL[3]	0.513	0.551	<DL	<DL	2.00	<DL	<DL	0.977	<DL	0.418	0.564	0.1 – 1.50[a]	4
Magnesium	2.8	16	18	12	17	130	11	16	18	13	19	28	10.1 – 27.4[a]	none
Potassium	1.4	2.8	6.0	1.7	3.0	9.5	1.7	2.4	3.2	2.8	4.1	6.6	1.2 – 5.8[a]	none
Sodium	7	14	30	6.1	17	1200	5.7	8.6	17	13	25	46	2.6 – 27.0[a]	none
Sulfate	8.2	24.2	41.9	1.0	32.9	153	12.8	23.7	28.4	18	46.1	84.4	9.6 – 40.4[a]	250*
Nutrients (mg/L)														
Total Nitrate plus Nitrite	<DL	0.64	2.6	<DL	1.4	290	0.023	0.82	1.6	0.54	1.9	5.5	<0.04 – 3.59[a]	10 for NO_3^- 1 for NO_2^-
Total Phosphorus	<DL	0.015	0.041	0.011	0.028	5.9	<DL	0.017	0.027	0.016	0.023	0.073	<0.01 – 0.02[b]	none
Trace Metals (µg/L)														
Arsenic	<DL	2.7	8.5	<DL	<DL	5.4	<DL	<DL	2.4	<DL	2.3	2.6	2 – 3[c]	10
Barium	20	64	80	30	87	1300	22	37	83	14	37	100	50 – 70[c]	2000
Chromium	<DL	1.5	5.6	<DL	6.8	78	<DL	5.9	10	1.1	2.2	3.9	<0.012 – 45[a]	100
Iron	<DL	<DL	38	<DL	<DL	21000	<DL	<DL	90	<DL	<DL	39	4 – 16[b]	300*
Lead	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	1.4	<DL	<DL	<DL	<5[c]	15
Manganese	<DL	2.8	36	<DL	<DL	2900	<DL	<DL	20	20	<DL	12	<1 – 4[d]	50*
Selenium	<DL	<DL	2.2	<DL	<DL	2.7	<DL	<DL	<DL	<DL	<DL	<DL	<1[c]	50
Zinc	<DL	<DL	<DL	<DL	<DL	520	<DL	6.2	100	<DL	<DL	150	<3 – 10.5[b]	5000*

[1] Background concentrations depend on local geology. Concentrations for sites not influenced by INL activities may still be higher than the given background ranges. Sources for background ranges are: [a] Bartholomay and Hall, 2016 (DOE/ID-22237); [b] Knobel and others, 1999 (DOE/ID-22164); [c] Knobel and others, 1992; [d] DEQ data compiled from distant, boundary, and surface water sites in previous years.

[2] Primary standard (MCL) unless otherwise noted. National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems. Maximum Contaminant Levels (MCLs) are the highest level of a contaminant that is allowed in the drinking water. Secondary standards (SMCLs) are designated with *. Secondary Drinking Water Regulations are non-enforceable guidelines regulating contaminants that may cause aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends but does not require that water systems comply with SMCLs.

[3] DL=Detection Limit.

Chloride

Chloride has been introduced to the ESRPA at the INL by the discharge of wastewater to the aquifer through injection wells and infiltration ponds. The primary source of chloride in INL wastewater is sodium chloride used to regenerate water softeners. TAN, INTEC, ATR, CFA, and NRF all have wells with chloride concentrations above background. Only one well monitored by DEQ, NRF-06 at NRF, has had chloride concentrations above the secondary maximum contaminant level (SMCL) of 250 mg/L. NRF-06 is located near the NRF industrial waste ditch, in which wastewater from water softeners is discharged. The chloride concentration measured in NRF-06 in 2018 was 415 mg/L, consistent with concentrations measured at this location since 2004 (**Figure 18**).

Most distant wells in the Magic Valley also had elevated chloride concentrations in 2018, with a maximum concentration of 68.4 mg/L at MV-54. High chloride concentrations in the Magic Valley are most likely tied to agriculture in the region, as salts in irrigation waters are concentrated by evaporation prior to recharging the aquifer.

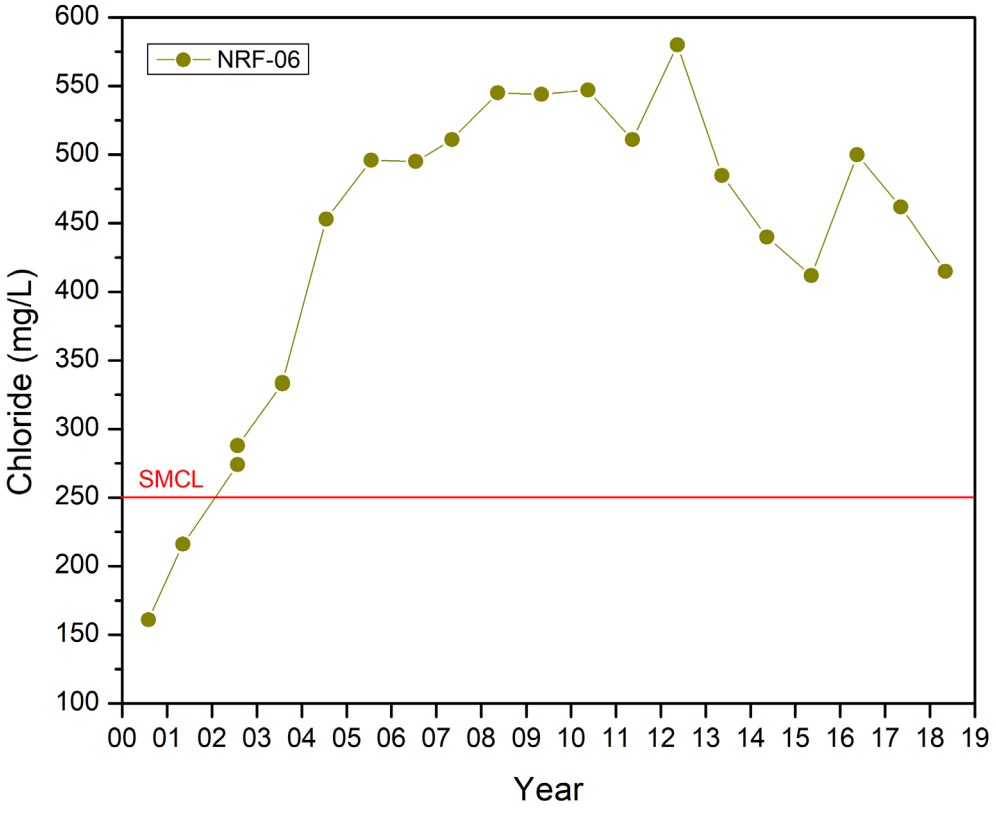

Figure 18. Chloride concentrations for sample location NRF-06 over time.

Nitrate plus Nitrite

In 2018, two wells exceeded the MCL of 10 mg/L for nitrate plus nitrite: TRA-08 at the ATR complex with a nitrate plus nitrite concentration of 290 mg/L and a perched groundwater well (USGS-073) with a concentration of 25 mg/L. Elevated concentrations of nitrogen (as nitrate and nitrite) are resultant from past wastewater disposal practices.

Chromium

Chromium was used to prevent corrosion in industrial water systems at the INL until the early 1970s. Disposal practices at that time allowed chromium-contaminated water to percolate down to groundwater from injection wells, open disposal ponds, and ditches, resulting in elevated chromium concentrations in some monitoring wells. In 2018, chromium concentrations were below the MCL of 100 µg/L at all locations sampled by DEQ, with a maximum concentration of 78 µg/L in ATR aquifer well TRA-07.

Results for wells that have historically had of high levels of chromium are shown in **Figure 19**.

A concentration map for all INL locations sampled in 2018 is shown in **Figure 20**.

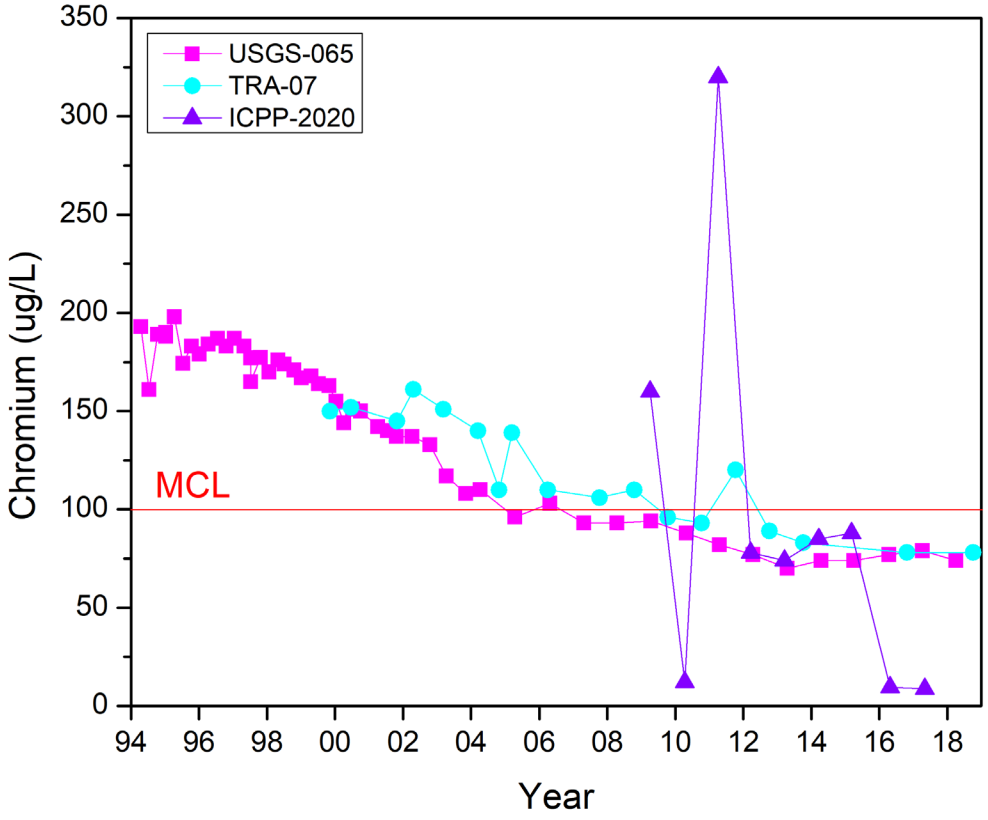

Figure 19. Chromium concentrations (µg/L) over time for selected aquifer wells at ATR and INTEC.

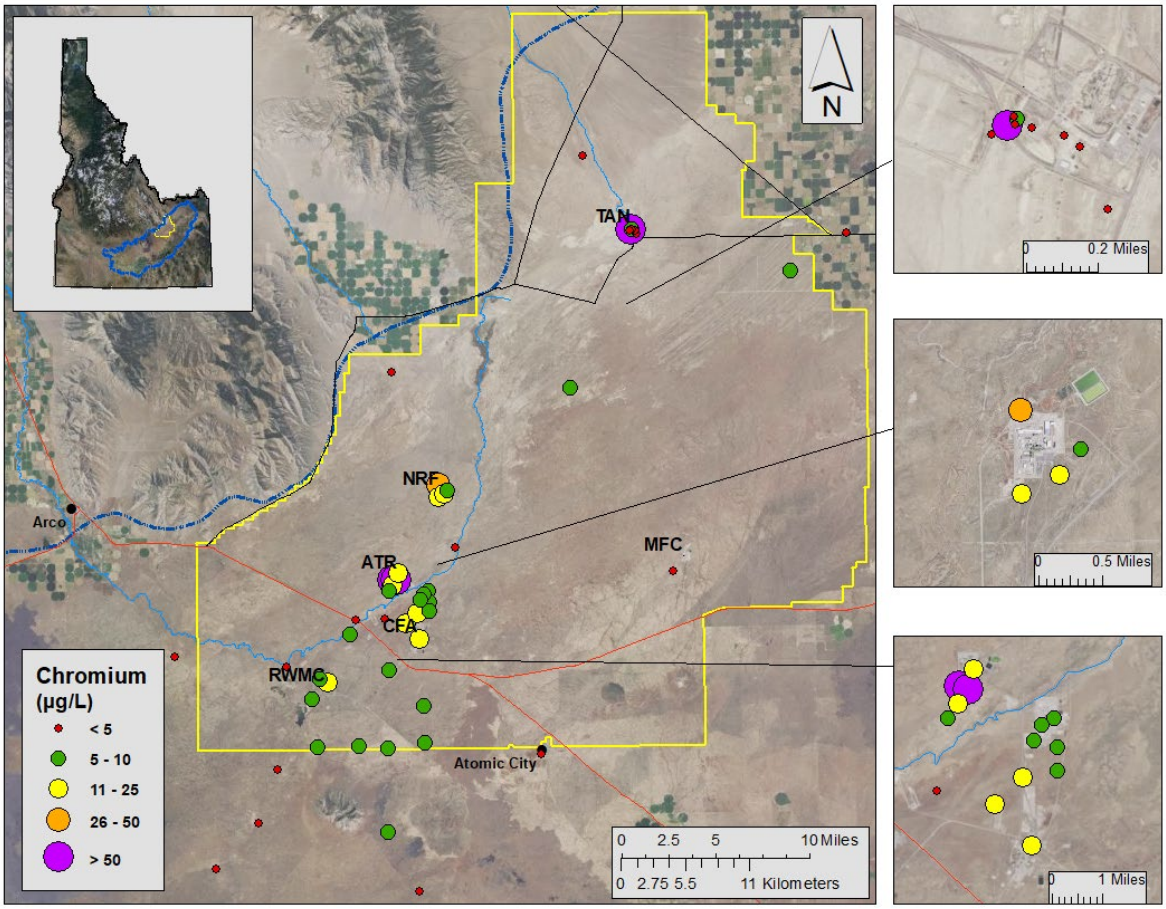

Figure 20. Chromium concentrations for DEQ sample locations in 2018 in and around the INL.

Manganese and Iron

Six wells at TAN exceeded the SMCL for manganese (50 µg/L) during the 2018 sample season. The maximum manganese concentration measured was 2900 µg/L at TAN-37, an increase from 1600 µg/L in 2017. The manganese concentrations also increased at TAN-28 (1400 µg/L from 1200 µg/L in 2017) and decreased at TAN-29 (140 µg/L from 180 mg/L in 2017). PW-9, a perched-groundwater well at ATR that had a manganese concentration of 26 µg/L in 2017, had an increased concentration of 60 µg/L of manganese in 2018.

Wells TAN-37A, TAN-2271, TAN 2272B, and TAN-10A also exceeded the SMCL for iron (300 µg/L) in 2018, with concentrations of 21,000, 4000, 8000, and 1400 mg/L, respectively.

Elevated concentrations of manganese and iron in the groundwater at TAN are consistent with reducing conditions created by in-situ bioremediation (ISB) as part of the clean-up action for volatile organic compounds (see next section). ISB injections were restarted at a new location, TAN-2272, in January 2016 and moved to TAN-37 in April of 2018. Manganese and iron concentrations are expected to increase and/or remain high at locations near and downgradient of TAN-37—including TAN-2271, TAN-2272, TAN-28, and TAN-29—as long as injections continue.

Volatile Organic Compounds

The primary volatile organic compound (VOC) contamination at the INL is located at and down-gradient of TAN, where a plume originating at a former wastewater injection well extends to the east and south. The plume is characterized by high concentrations of trichloroethene (TCE) and its degradation products (cis-1,2-dichloroethene [cis-DCE], trans-1,2-dichloroethene [trans-DCE], and vinyl chloride [VC]) and lower concentrations of tetrachloroethene (PCE). The plume has been divided into three regions based on TCE concentrations reported in 1997 (INEEL/EXT-97-00931), and a different remediation strategy was chosen for each region in a 2001 Record of Decision Amendment (DOE/ID-10139):

- The hot spot (>20,000 µg/L TCE) covers a small area immediately surrounding the former injection well. The remediation strategy here has been in situ bioremediation (ISB), which involved repeated injection of a carbon source (whey and sodium lactate) into the aquifer to promote anaerobic reduction of chlorinated ethenes in the aquifer. Injections began in 1999 and were halted in 2012.
- The medial zone (1,000 to 20,000 µg/L TCE) extends about 1500 feet east-southeast from the hot spot as a narrow lobe. The remediation strategy here is to pump, treat, and reinject groundwater.
- The distal zone (5 to 1,000 µg/L TCE) surrounds the medial zone as a much larger lobe that extends about 900 feet west and 1.7 miles southeast of the hot spot. The remediation strategy here is monitored natural attenuation.

In July 2012, ISB injections were suspended indefinitely in order to initiate the rebound test—a multi-year pause in ISB treatment to evaluate residual VOC contamination in the aquifer once background groundwater conditions returned. In January 2016, ISB injections commenced at TAN-2272, a new well installed in 2015, to treat an apparent residual TCE source in the vicinity of TAN-28. A partial ISB rebound test continues in the vicinity of the original hot spot.

In 2018, DEQ sampled seven wells in the medial zone east of the pre-2012 ISB treatment area (TAN-28, TAN-29, TAN-42, TAN-44, TAN-47, TAN-10A, and TAN-2271). Three VOCs were detected at concentrations above the MCL in TAN wells: TCE (MCL = 5 µg/L) at TAN-28, TAN-29, and TAN-42, TAN 44, TAN-47, TAN-10A; PCE (MCL = 5 µg/L) at TAN-29 and TAN-10A; and Vinyl Chloride (MCL = 2 µg/L) at TAN-28. **Figure 21** shows TCE concentration trends for TAN-28, TAN-29, and TAN-37A. TCE concentrations in TAN-28 and TAN-29 have varied widely over time, probably as a result of intermittent changes in groundwater chemistry due to ISB injections as well as seasonal changes in groundwater flow (DOE/ID-11444), but clearly remained high throughout the rebound test. In 2018, TCE concentrations in both wells (154 µg/L at TAN-28, 526 µg/L at TAN-29) were significantly lower than in 2017 but still within the range measured at these locations over the past 15 years.

Other VOC detections in 2018 were at RWMC, where TCE, carbon tetrachloride (MCL = 5 µg/L), and/or chloroform (MCL = 70 µg/L) were detected in three wells. Only one of these detections—carbon tetrachloride in well RWMC Production (5.09 µg/L) was above the MCL. The VOC detections at RWMC are consistent with historical observations.

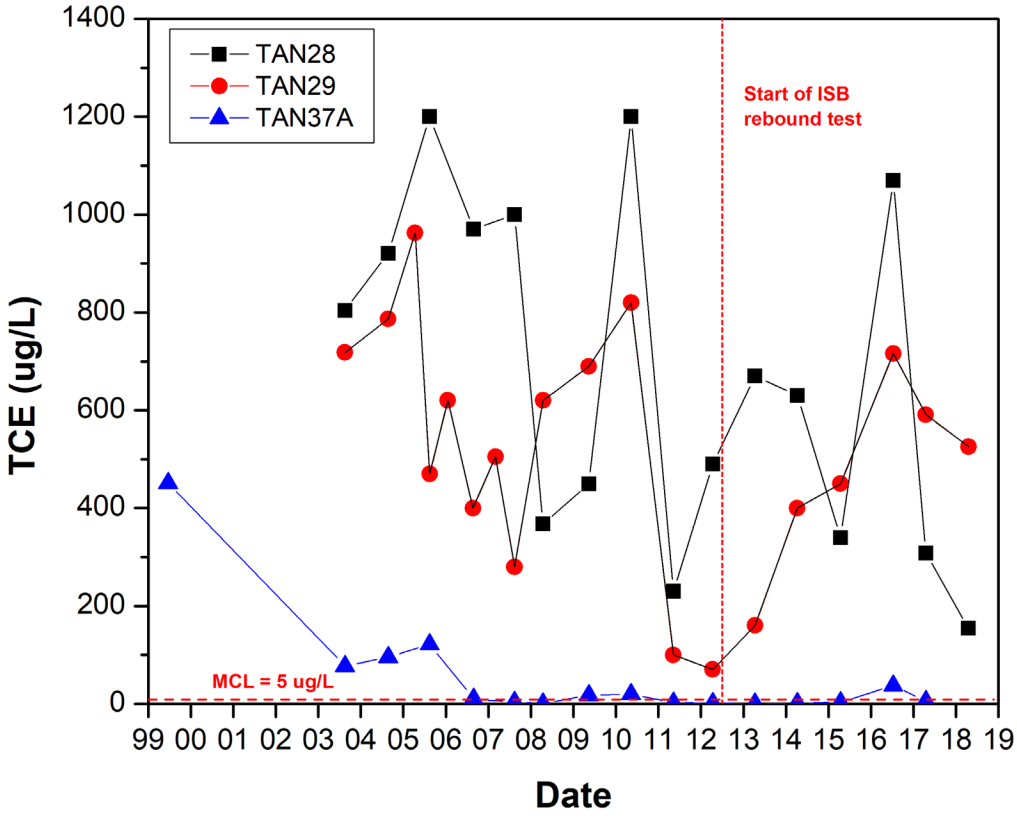

Figure 21. TCE concentrations (µg/L) over time for selected wells located in the medial zone at TAN.

Water Monitoring Verification Results

DEQ collects water samples at the same time and location as DOE contractors or the USGS and verifies that analytical results from co-sampled locations are consistent. The DEQ sampling verification program is designed to co-sample at approximately 10% of all DOE sample locations for selected analytes. In the event that a significant difference is found between DEQ results and those of the co-sampler, each result is scrutinized individually to ascertain the cause of the difference. Some differences between results are expected due to natural variability in the media being sampled, random errors in the measurements, and systematic differences in how the samples are collected, handled and analyzed. DEQ sets a goal of at least 80 percent of the results from co-sampled locations for each analysis passing the comparison criteria outlined in the Quality Assurance section.

Radiological

A summary of the sample-by-sample comparison of DEQ and DOE/USGS radiological results is presented in **Table 6**. Most results were in agreement, with at least 80 percent of results for co-sampled pairs passing comparison criteria for all analyses except gross beta radioactivity and Technetium-99. The reason for the differences in gross beta results is unknown at present, but it

is notable that for all sample pairs failing to pass the comparison criteria, the result obtained by DEQ was larger than the result obtained by the co-sampler, suggesting a systematic bias. This issue will be investigated further in the coming year.

Table 6. Radiological results for co-samples collected by DOE and DEQ in 2018.

Analyte	Number of co-sampled pairs in 2018	Percent of co-sampled pairs passing criteria in 2018	Percent of USGS co-sampled pairs passing criteria in 2018	Percent of Fluor co-sampled pairs passing criteria in 2018	Percent of Veolia co-sampled pairs passing criteria in 2018	Percent of BEA co-sampled pairs passing criteria in 2018
Gross alpha	43	91	96	75	83	100
Gross beta	43	74	81	25	75	100
Cesium-137	25	92	89	100	---	100
Tritium	71	96	96	100	92	100
Strontium-90	30	90	86	100	---	---
Technetium-99	4	50	---	50	---	---
Uranium-234	5	100	---	100	---	---
Uranium-235	5	100	---	100	---	---
Uranium-238	5	100	---	100	---	---
Plutonium-238	6	100	100	100	---	---
Plutonium-239 + 240	6	100	100	100	---	---
Americium-241	3	100	100	---	---	---

Non-Radiological

A summary of the sample-by-sample comparison of DEQ and DOE/USGS non-radiological results for 2018 is presented in **Table 7**. Nearly all results were in agreement, with at least 80 percent of results for co-sampled pairs passing comparison criteria for all analyses except for barium, chromium, and zinc. Fluor obtained results with lesser concentrations than DEQ of barium and chromium but higher concentrations in zinc.

Table 7. Non-Radiological results for co-samples collected by DOE and DEQ in 2018.

Analyte	Number of co-sampled pairs in 2018	Percent of co-sampled pairs passing criteria in 2018	Percent of USGS co-sampled pairs passing criteria in 2018	Percent of Fluor co-sampled pairs passing criteria in 2018	Percent of BEA co-sampled pairs passing criteria in 2018
Common Ions/Nutrients					
Alkalinity	10	100	---	100	---
Calcium	9	100	100	100	---
Chloride	52	98	98	100	100
Fluoride	---	---	---	---	---
Magnesium	9	100	100	100	---
Potassium	5	100	---	100	---
Sodium	50	100	100	100	---
Sulfate	53	94	98	80	100
Total Nitrate plus Nitrite	45	98	100	83	100
Total Phosphorus	21	100	100	---	---
Trace Metals					
Arsenic	6	100	100	100	---
Barium	6	83	100	0	---
Chromium	38	87	89	0	100
Iron	9	100	100	100	100
Lead	6	100	100	100	---
Manganese	7	100	100	100	100
Selenium	7	100	100	100	---
Zinc	6	83	100	0	---
VOCs[1]					
10 VOC analytes	45	93	96	90	---

[1]VOCs were analyzed by DEQ at seven co-sampled locations. DEQ's results were compared with those of the co-sampler for analytes that were detected in at least one sample.

Water Monitoring and Verification Impacts and Conclusions

DEQ sample results are mostly in agreement with those reported by DOE contractors and the USGS. Results of DEQ water monitoring have identified contamination in the Eastern Snake River Plain Aquifer as a result of historic waste disposal practices at the INL. Specifically:

- Concentrations of gross alpha, ^{90}Sr, chloride, manganese, iron, nitrate plus nitrite, and some VOCs exceeded federal drinking water standards (MCLs or SMCLs) at some sites on the INL in 2018. These sites are not used for drinking water.
- Tritium was detected at a concentration above background in the vicinity of the southern INL boundary; no sites monitored by DEQ exceed federal drinking water standards for tritium. Concentrations of tritium at the INL continue to decline site-wide.
- Concentrations for other INL contaminants in water remain constant or continue to decrease at most locations as a result of changes in waste disposal practices. Chromium concentrations remained below the 100 µg/L MCL at all sites sampled by DEQ in 2018.
- INL impacts to the aquifer are not identifiable in water samples collected at sites distant from the INL.

Terrestrial Monitoring

Terrestrial monitoring is performed by measuring radionuclide accumulations in soil to help assess long-term trends of radiological conditions in the environment on and around the INL. Monitoring of milk samples is performed to indirectly verify the presence or absence of

atmospheric radioiodine deposited in the terrestrial environment on and near the INL. Some of these data are also used to determine whether the monitoring results obtained by the DOE and its contractors were consistent with the soil and milk sampling results obtained by DEQ for these same locations.

Terrestrial Monitoring Equipment and Procedures

DEQ uses a combination of *in-situ* gamma spectrometry and physical soil samples to monitor concentrations of gamma-emitting radionuclides in soil at DEQ air monitoring stations and selected soil sampling sites on and around the INL (2018 soil sampling sites are shown in **Figure 22**). A portable gamma radiation detector was used in the field to collect surface gamma radiation measurements. These *in-situ* sampling measurements were then used to identify radionuclides present and to estimate soil radioactivity concentrations. Physical soil samples were also collected at 12 locations during 2018.

DEQ collected milk samples from distribution centers where milk was received and from individual dairies in southern and southeastern Idaho. Milk sampling locations are shown in **Figure 1.** Raw milk samples were collected from trucks arriving at the distribution centers from each region of interest. For the independent cow and goat dairies, DEQ personnel drop off empty sample containers that are filled by the owner/operator of the dairy. The samples are picked up within 1-2 days of collection.

Two DEQ milk samples were collected and split by a DOE contractor each month. One half of the split samples were analyzed by DOE and the other half were submitted to DEQ for analysis. DEQ used the analysis results from these split samples to verify the DOE contractor's milk sampling results and conclusions.

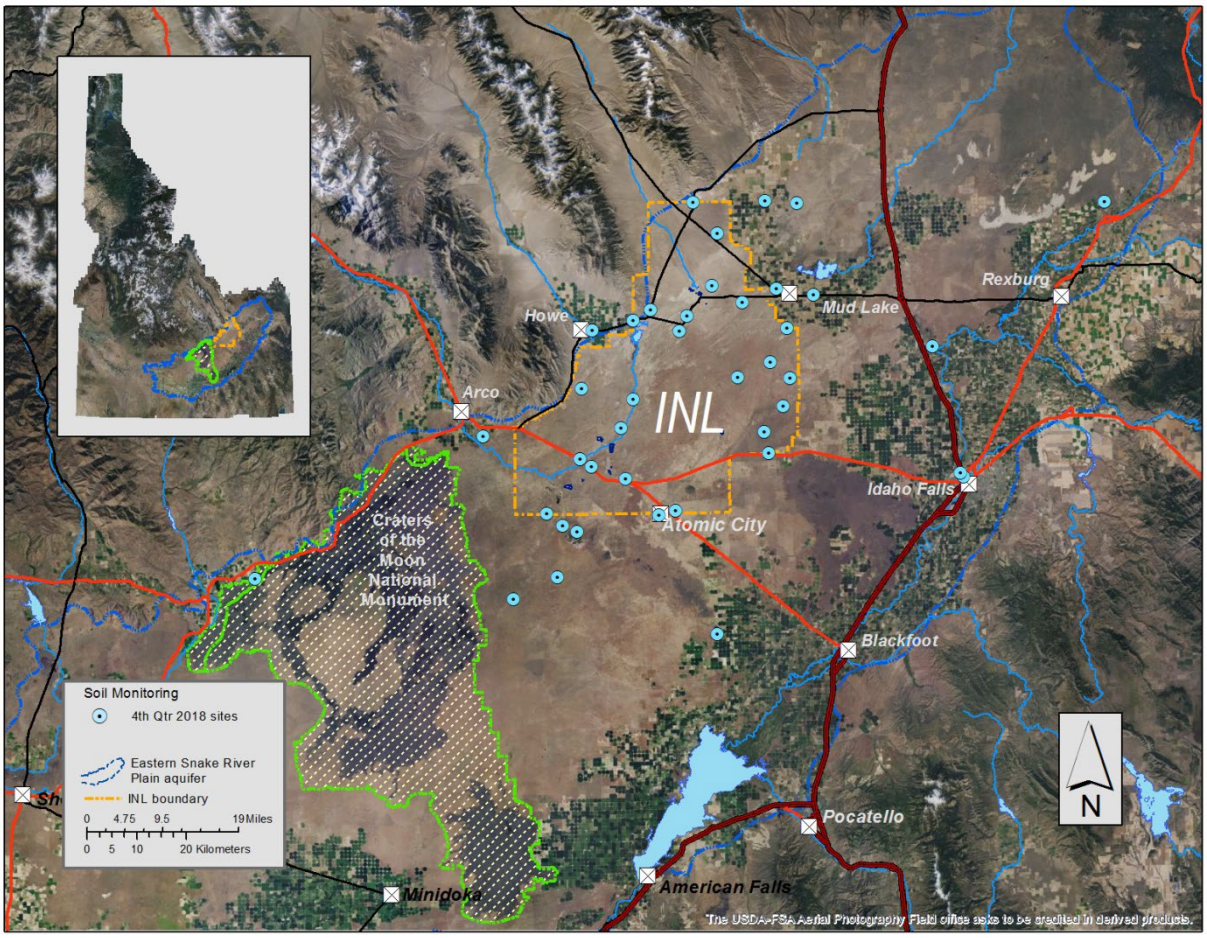

Figure 22. DEQ soil sampling locations for 2018.

Terrestrial Monitoring Results and Trends

Monitoring concentrations of gamma-emitting radionuclides in surface soil provides insight to the transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations and historic atmospheric testing of nuclear weapons. During 2018, DEQ made *in-situ* gamma spectrometry measurements to estimate accumulations of gamma-emitting radionuclides in surface soil at 40 locations. Of the 40 measurements, Cesium-137 (^{137}Cs) was the only man-made radionuclide that was detected. The average ^{137}Cs value for *in-situ* measurements was 0.12 picocuries per gram (pCi/g) with a minimum value of 0.04 pCi/g and a maximum of 0.19 pCi/g. All results were well below the recommended federal screening limit for surface soil of 6.8 pCi/g of Cesium-137 (NCRP Report 129).

Milk sampling is conducted by DEQ to determine whether radioiodine is present or absent in the food supply. Radioiodine is produced in relatively large quantities during fission reactions (e.g., in nuclear reactors). The chemical nature of iodine makes it mobile under normal conditions. Gaseous radioiodine can be dispersed through the atmosphere and carried along with the wind until it is deposited on plants. Dairy cows and goats that graze on radioiodine-contaminated pasture or feed will accumulate iodine in the milk they produce. Drinking this milk could lead to an accumulation of radioiodine in the thyroid gland and a greater risk of thyroid cancer.

During 2018, DEQ analyzed 41 milk samples. Radioiodine (^{131}I) was not detected in any milk sample. The DEQ action level of 4.4 pCi/L is based upon the radioiodine concentration in milk necessary for an infant to receive an annual thyroid radiation dose of 5 millirem. The Food and Drug Administration (FDA) recommended maximum concentration of ^{131}I for food, including milk, is 4600 pCi/kg.

Terrestrial Monitoring Verification Results

Naturally occurring Potassium-40 (^{40}K) is present in milk and soil and is ideal as a quality control measurement and indicator of measurement sensitivity. Therefore, many of the comparisons conducted between DEQ and DOE sample results include this isotope, especially since the target radionuclide (such as Iodine-131) is seldom detected in milk samples.

Gamma spectroscopic analysis results of the 24 milk split samples collected by the DOE contractor and submitted to DEQ for analysis were compared with DOE results. ^{40}K results obtained by DEQ showed 96% agreement with DOE contractor results. All ^{131}I results were below the minimum detectable activity for both agencies.

The DOE contractor did not conduct any in-situ soil sampling in 2018.

Gamma spectrometry results from physical soil samples taken at twelve co-located sample sites both on and off-site were compared with the DOE contractor's results. There was 75% agreement between the agencies with the average results for ^{137}Cs of 0.24 pCi/g (minimum 0.12 pCi/g and maximum 0.48 pCi/g) for DEQ and 0.33 pCi/g (minimum 0.19 pCi/g and maximum 0.64 pCi/g) for the DOE contractor. These results were well below the DEQ action level and the recommended screening limit of 6.8 pCi/g for surface soil (NCRP 129).

Terrestrial Monitoring Impacts and Conclusions

Based upon terrestrial radiological measurements of soil and milk, there were no discernable impacts to the environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

Quality Assurance for the ESP

Data Assessment Summary

This section summarizes the results of the quality assurance (QA) assessment of the data collected during calendar year 2018 by the DEQ's Environmental Surveillance Program. All analyses and quality control (QC) measures at the analytical laboratories used by the DEQ were performed in accordance with approved written procedures maintained by each laboratory. Sample collection and those analyses performed by DEQ were in accordance with written procedures maintained by the DEQ.

During calendar year 2018 the DEQ submitted QC samples for 307 radiological and non-radiological analyses, representing 11.2 percent of the 2750 field sample analyses completed. Analytical results for these QC samples (180 blank results, 84 duplicate results, and 43 spike results) were used to assess the precision, accuracy, and representativeness of results from

analyzing laboratories. All analytical results for QC samples and field samples are found in the DEQ quarterly reports for 2018.

During 2018, three QC blank results, four QC duplicate results, and one QC spiked sample result failed DEQ acceptance criteria for groundwater. These failures resulted in seven associated groundwater field sample results being qualified as estimates (one enriched tritium, two VOCs, three gross alphas, and one zinc) and two groundwater manganese results qualified as rejected. Also, one nitrate plus nitrite and one total phosphorus result were qualified as rejected due to an incorrect preservative added to the sample.

Also during 2018, 36 gross alpha and 36 gross beta results for weekly TSP air samples were qualified as rejected, all due to insufficient air sample volume. Of these 72 rejected results, 54 were due to excessive filter loading from wildfires.

Also during 2018, two results for ^{137}Cs in physical soil samples were qualified as estimates due to a probable labeling error.

The overall 2018 data usability (non-rejected results divided by total field sample results obtained) was acceptable at 97.2%. In addition to the 2750 field sample analysis results completed, another 23 expected results were not obtained for 2018, due primarily to TSP sampler issues and environmental radiation detector electronic issues. The overall 2018 data completeness (non-qualified results divided by total field sample results expected) was acceptable at 96.1%. The field data were validated, assigned qualifiers to designate restrictions on their use, and deemed usable and complete, meeting the program's data quality objectives.

Issues and Problems

No major issues or problems affecting data quality were identified during 2018.

Comparing Data

DEQ compares its data with DOE's to determine whether the programs' data sets are statistically equivalent, or if each program's data support the same conclusions relative to environmental impacts and public health. To evaluate statistically the degree of agreement between organizations' split sampling and co-sampling measurements, DEQ evaluates the Relative Percent Difference (RPD) between paired sample results using the following equation:

RPD = ((DOE result – DEQ result) / ((DEQ result + DOE result)/2)) x 100

An RPD in the range of ±20% is considered to indicate acceptable agreement between measurements. For non-radiological analysis, the RPD is used to compare paired samples in which both of the results exceed five times the detection level. If one or both of the 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 larger method detection limit.

For radiological analysis, the RPD is calculated (using the above equation) to compare paired samples if both results are greater than the sample-specific minimum detectable concentration

(MDC). DEQ also considers paired sample results with an absolute difference of no more than three times the pooled error (or "3 sigma") to be in acceptable agreement. This is accomplished using the following equation:

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

Where:
R_1 = First sample value.
R_2 = Second sample value.
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.

Individual pairs of radiological measurements having an absolute difference of no more than three times their pooled uncertainty, or with an RPD in the range of $\pm$20%, are considered to be statistically in agreement.

Paired data sets are considered to be in satisfactory statistical agreement if at least 80% of the individual paired results are in agreement.

Radiological Emergency Response Planning and Preparedness

DEQ's role in emergency response planning and preparedness is defined in detail in the Environmental Oversight and Monitoring Agreement (EOMA) with the DOE. DEQ works with DOE and INL contractors to evaluate and participate in response planning, and to respond to incidents. DEQ works with state, federal and local agencies to respond to incidents, as described in the Idaho Hazardous Materials Response Plan. The Idaho Bureau of Homeland Security (IBHS) coordinates state emergency response actions in Idaho. Most of DEQ's emergency response activities are directed towards planning and response to INL incidents. DEQ also responds to non-INL radiological incidents to help maintain lines of communication with the State's emergency response organization, and as opportunities to test organizational readiness under real-world conditions. As a part of public outreach, DEQ can provide technical information, assistance, and training to local and state authorities for incidents involving radioactive materials at the INL or elsewhere in Idaho.

By agreement with DOE, INL radiological incident response planning is based on hazard assessment documents (HADs) developed by DOE contractors. These documents describe potential incidents at INL facilities that could release radionuclides to the environment. Review of current INL HADs is a key element of preparing for INL radiological emergencies. This information allows DEQ to identify scenarios that could potentially result in off-site radiological impacts, and plan appropriate responses. DEQ uses the source inventory and accident scenarios from the HADs to develop input for atmospheric dispersion and dose modeling using the Radiological Assessment System for Consequence Analysis (RASCAL) code. RASCAL uses real time National Oceanic and Atmospheric Administration (NOAA) weather data for regional-scale dispersion modeling. This allows DEQ to make independent radiological dose assessments

for planning purposes, and would support development of timely technical and protective action recommendations for state authorities during actual emergencies. DEQ also receives text messages from the INL Warning Communication Center anytime their emergency resources are deployed; primarily the INL Fire Department.

Non-INL Radiological Activities

1. DEQ-INL OP manager and/or staff members participated in 17 regional and county emergency planning meetings.
2. DEQ-INL OP manager and one staff member attended the National Transportation Stakeholders Forum meeting in 2018.
3. DEQ-INL OP staff member attended the fall 2018 WIPP Technical Advisory Board meeting in Portland, Oregon
4. DEQ-INL OP staff member attended the fall 2018 Western Interstate Energy Board High Level Waste Committee meeting in San Diego.
5. DEQ-INL OP staff member served on the Idaho Office of Emergency Management (IOEM) State Hazard Mitigation Planning Committee working on radiation sections of the Hazardous Materials (HazMat) plan.

Drills and Exercises

1. DEQ-INL OP staff participated in multiple INL drills and exercises; any time the Emergency Operations Center (EOC) was activated DEQ-INL OP staff members were in the EOC running plume/dose projections and interfacing with EOC personal.
2. DEQ-INL OP staff member participated in the Radiological Assistance Program Training for Emergency Response (RAPTER) week long training course in Las Vegas, which included a large scale radiological exercise in Las Vegas involving multiple city/state/federal agencies and players.
3. DEQ-INL OP staff member participated in the 101st Civil Support Team radiological emergency response graded exercise at the College of Easter Idaho in Idaho Falls.

Waste Isolation Pilot Plant Shipment Safety

DOE contracts with the Western Governors Association (WGA) to coordinate activities related to the safe shipment of transuranic waste to the Waste Isolation Pilot Plant (WIPP) through western states. DEQ works with the Idaho State Police (ISP) and the Idaho Office of Emergency Management to manage WIPP shipment safety activities on the US Route 20/26, Interstate 15, and Interstate 84 / 86 corridors in Idaho.

During 2018, DEQ:

1. Oversaw radiological equipment repairs and calibrations for ISP, all seven Idaho regional response teams, the Shoshone-Bannock Tribes, and three area hospitals.
2. Staff members attended the National Transportation Stakeholders Forum and two meetings of the WIPP Technical Advisory Group and Western Governors Association

WIPP Technical Advisory Group. DEQ staff also participated in monthly conference calls with the WIPP Technical Advisory Group.

3. Two DEQ-INL OP staff members attended and toured the WIPP facility in New Mexico.

Emergency Response

- During 2018, DEQ INL-OP staff responded to an Idaho State Emergency Medical Services Communications Center (StateComm) initiated emergency call about a metal container in a Dubois, Idaho recycling facility that had radiation designated symbols attached.

Planning and Preparedness Meetings

1. DEQ-INL OP staff attended eleven Local Emergency Planning Committee (LEPC) meetings, and the six regional emergency planning meetings. DEQ-INL OP Manager and/or staff attended multiple Northwest Emergency Managers Workshops.
2. DEQ-INL OP staff attended multiple INL Citizens Advisory Board Meetings in 2018.

Classes and Presentations

1. All DEQ-INL OP staff received training in INL Web Emergency Operations Center access and database.
2. DEQ-INL OP Staff participated in the 2018 HazMat week in Boise, Idaho providing radiological training to Idaho emergency personal from all over the state.
3. DEQ-INL OP Staff member provided radiological emergency response training to hospital staff at the Lost River Medical Center in Arco, Idaho.

Public Outreach

A fundamental aspect of DEQ's work is sharing our findings with the public and factoring public input into our activities and policy recommendations. DEQ uses several tools to provide Idahoans with independent, accurate, and timely information about activities relating to the INL and other DOE activities in Idaho – publications, events, our Web site, and our community monitoring network.

Publications

DEQ regularly issues technical and non-technical publications to communicate the findings and activities of our program. In 2018, we issued:

- The DEQ-INL OP Annual Report for 2017.
- Four quarterly environmental surveillance data reports.

DEQ-INL OP publications are available at
http://www.deq.idaho.gov/inl-oversight/monitoring/reports.aspx.

Presentations and Events

DEQ also communicates with the public about INL-related issues through schools, fairs, special interest groups, and public events. In 2018, we gave public presentations on the aquifer, and INL Site information to a range of schools, civic groups, and special interest groups.

The Water Festival begins with a distribution of water education materials to approximately 3100 eastern Idaho students from 44 schools. Each year, some of the students from the Water Festival participate in the Poetry contest. The poems and winners are displayed in the Idaho Falls Library three weeks prior to the event (**Figure 23**). The event has now grown so large that we have extended it to two days attended by a total of over 1,600 students. The Rain Stick and Physics of Water activities are presented to students (**Figures 24 and 25**).

Idaho Falls Earth Day continues to offer several activities for the youth and adults to enjoy. DEQ provides an Edible Aquifer activity to teach about the importance of water in our aquifer (**Figure 26**). DEQ-INL OP provides carry-all bags with Earth Day giveaways at the booth (**Figure 27**).

Figure 23. Water Awareness Poetry Contest 2018 on display at the Idaho Falls Library.

Figure 24. Children enjoying the "Rainstick" activity at Water Festival 2018.

Figure 25. Children watching the "Physics of Water" demonstration at the Water Festival event 2018.

Figure 26. Children participating in the Edible Aquifer activity at the 2018 Earth Day event.

Figure 27. DEQ staff handing out give-away items at the 2018 Earth Day event.

Community Monitoring Network

DEQ also participates in a community monitoring network in Eastern Idaho in cooperation with the Shoshone-Bannock Tribes, the U.S. Department of Energy, and NOAA. Strategically located community monitoring stations provide real-time atmospheric and radiological data to the public at each station location and also transmit data to the World Wide Web at http://www.idahoop.org/. In June of 2018, the Idaho Falls Monitoring Station that is located on the Greenbelt was destroyed by an inattentive driver. We began the process of removing and rebuilding the structure. (**Figure 28**). The construction of the new station began in early July and was completed in November. (**Figure 29).**

Figure 28. Idaho Falls Community monitoring station at the Greenbelt after the destruction.

Figure 29. The newly constructed Idaho Falls Community monitoring station completed in October 2018.