DEQ-INL
OVERSIGHT PROGRAM
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Department of Environmental Quality
Idaho National Laboratory Oversight Program

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Table of Commonly Referenced Radionuclides		
Element	**Atomic Mass**	**Symbol**
Americium	241	^{241}Am
Cesium	137	^{137}Cs
Hydrogen	3	^{3}H (Tritium*)
Iodine	131	^{131}I
Potassium	40	^{40}K
Plutonium	238	^{238}Pu
Plutonium	239/240	$^{239/240}$Pu
Strontium	90	^{90}Sr
Technetium	99	^{99}Tc
Uranium	234	^{234}U
Uranium	235	^{235}U
Uranium	238	^{238}U

*Commonly referred to as “tritium”, common reference was used throughout this report.

Table of Acronyms and Abbreviations

aCi/m^3	attocuries per cubic meter
APGEMS	Air Pollutant Graphical Environmental Monitoring System
ARP	Accelerated Retrieval Project
AMWTP	Advanced Mixed Waste Treatment Project
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
BHS	Bureau of Homeland Security
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CWI	CH2M-WG Idaho, LLC
DEQ-INL OP	Department of Environmental Quality, Idaho National Laboratory Oversight Program
DOE	U.S. Department of Energy
EIC	electret ionization chamber
EML	Environmental Monitoring Laboratory
EPA	Environmental Protection Agency
ESER	Environmental Surveillance Education and Research Program
ESP	Environmental Surveillance Program
fCi/m^3	femtocuries per cubic meter
GSS	Gonzales-Stoller Surveillance, LLC
HAD	hazard assessment document
HPIC	high-pressure ion chamber
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISP	Idaho State Police
ISU	Idaho State University
LLD	lower limit of detection
LSC	liquid scintillation counting
MFC	Materials and Fuels Complex
MCL	maximum contaminant level
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
NIST	National Institute of Standards and Technology
nCi/L	nanocuries per liter
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
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
RWMC	Radioactive Waste Management Complex
RTC	Reactor Technology Complex
SBW	sodium-bearing waste
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
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
WLAP	wastewater land application permit

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.
- Evaluating potential INL Site operational impacts to the public and the environment.
- 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-INL OP during 2012. The report is divided into sections covering the Environmental Surveillance Program (ESP), Assessment of INL Site Impacts, Radiological Emergency Response Planning and Preparedness, and Public Outreach.

Environmental Surveillance Program

DEQ-INL OP 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-INL OP 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 Gonzales-Stoller, LLC (GSS), United States Geological Survey (USGS), CH2M-WG Idaho, LLC (CWI) and the prime INL contractor, Battelle Energy Alliance (BEA). GSS 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.

DEQ-INL OP also provides the citizens of Idaho with an independent evaluation of information concerning DOE program operations. This information enables the public to reach informed conclusions about DOE activities in Idaho and potential impacts to public health and the environment.

In order to present sampling results to the public and interested agencies, DEQ-INL OP publishes quarterly and annual reports. Each quarterly report contains detailed data and results of the DEQ-INL OP 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 2012, DEQ-INL OP 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. DEQ-INL OP also detected small quantities of tritium in the ground water near the southern boundary of the INL Site, which are attributed to historic INL Site operations. These concentrations, although greater than natural background levels, were less than 2 percent of the drinking water standard for tritium. No other contaminants attributable to INL Site operations were identified in ground water samples collected outside of the INL Site.

Environmental measurements made by DEQ-INL OP within the INL Site in 2012 were consistent with past results. Water samples collected from on-site locations near INL Site facilities identified concentrations of ^{90}Sr (strontium-90), chromium, chloride, manganese, and 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
$0.00000000000000001 = 10^{-18}$	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 1 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 2012 monitoring in terrestrial media and air were generally consistent with historic trends. Radiation levels were consistent with historic background measurements. Concentrations of ^{90}Sr, chromium, chloride, manganese, and VOCs exceeded federal drinking water standards at locations on the INL in 2012. 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-INL OP and the DOE. This level of comparability between DEQ-INL OP 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-INL OP'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-INL OP monitoring sites) are shown in **Figure 1** and continuous air monitoring stations are shown in **Figures 2 and 3**.

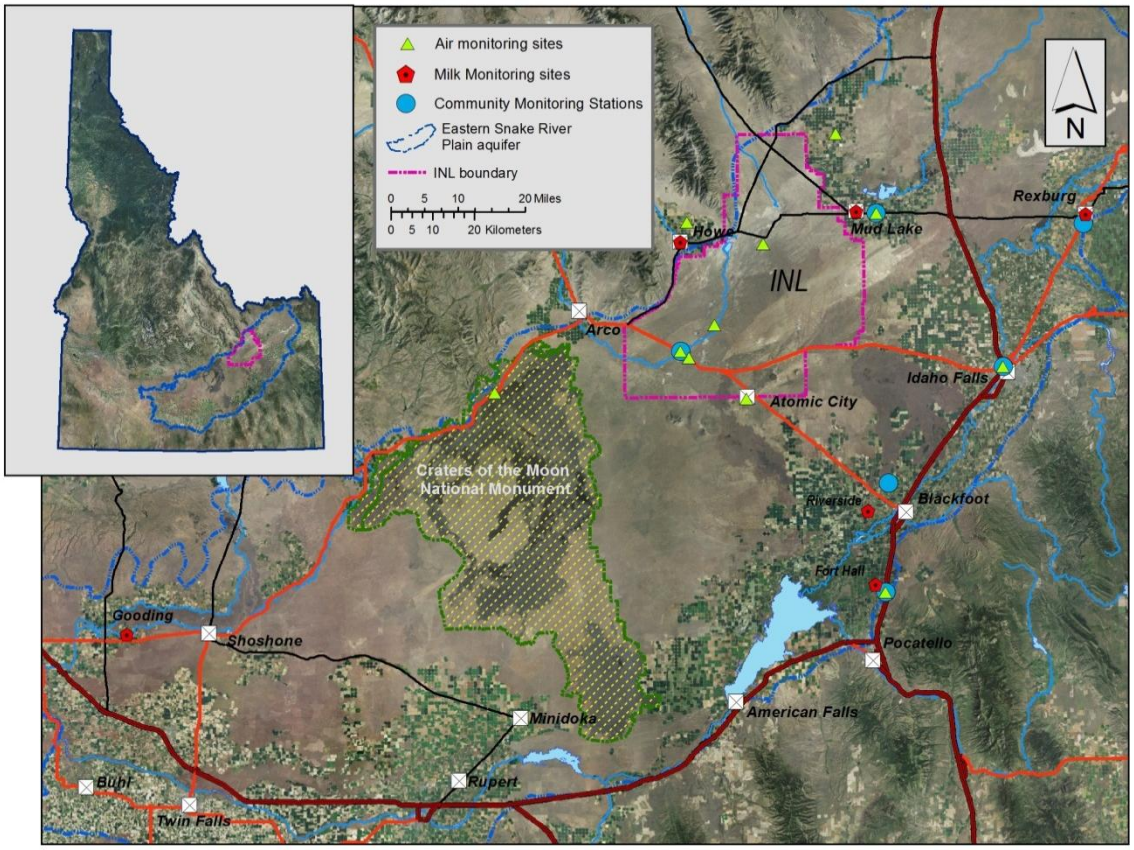


Figure 1. Locations of selected DEQ-INL OP monitoring sites.

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

Air monitoring stations are segregated into three categories:

- 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 or background locations are used for data comparisons and include the Craters of the Moon visitor center, Idaho Falls, and Fort Hall.

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

Particulate air samples (i.e., 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-INL OP air monitoring station with all four different types of sampling equipment is pictured in **Figure 4.**

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

In order to verify results, data collected by DEQ-INL OP 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 using a high-volume total suspended particulate (TSP) matter air sampler. 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 quantity 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, ^{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 up, 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 sampling involves the collection of precipitation using a collection tray that is heated during the winter months. At the end of each calendar quarter or once the 5-gallon sample container is full, whichever occurs first, the water sample is collected and analyzed for tritium and for gamma-emitting radionuclides.

All samples collected from DEQ-INL OP'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. Results presented below are calculated using the actual sample volumes, i.e., the volumes at ambient temperature and pressure.

Particulate Matter in Air

A total of 554 filters from TSP samplers were collected during 2012. 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 2012 were less than the OP 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 2012.

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)
2012	0.1 to 8.5	1.2 ± 0.1	7.3 to 125.1	26.4 ± 0.6

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

For the quarterly TSP filter composite samples, the only reported gamma-emitting radionuclide was ^{7}Be (beryllium-7), a naturally occurring, cosmogenic radionuclide. Radiochemical analysis of the annual TSP filter composite samples showed concentrations of ^{90}Sr from 0.1 to 4.5 attocuries[1] per cubic meter (aCi/m^3) for 2012. Of the transuranic radionuclide analytes (^{238}Pu, $^{239/240}Pu$, and ^{241}Am), $^{239/240}Pu$ was detected at the Experimental Field Station with a value[2] of

[1] An attocurie is 10^{-18} curies, or 1/1000th of a femtocurie.
[2] Analytical uncertainties reported as 1 standard deviation.

1.32 ± 0.45 aCi/m^3 (MDC 0.4 aCi/m^3), and Van Buren with a value of 1.46 ± 0.46 aCi/m^3 (MDC 0.4 aCi/m^3). These values are within the expected range due to global fallout from historic above-ground weapons testing. ^{241}Am was detected at the Rest Area location with a value of 3.1 ± 1.1 aCi/m^3 (MDC 3.0 aCi/m^3). All of these concentrations are much less than one percent of the federal regulatory limits for ^{238}Pu (2.1 fCi/m^3), $^{239/240}$Pu (2.0 fCi/m^3), ^{241}Am (1.90 fCi/m^3), and ^{90}Sr (19 fCi/m^3), (40 CFR 61).

Atmospheric Tritium

A total of 142 atmospheric moisture samples were collected in 2012 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-INL OP on the INL in 2012 were 1.19 ± 0.65 pCi/m^3 at the Experimental Field Station for the time period of September 6 through September 27, 2012, 1.33 ± 0.79 pCi/m^3 at Van Buren Avenue for the time period of June 28 through July 19, 2012, 0.83 ± 0.76 pCi/m^3 at the Big Lost River Rest Area station for the time period of June 28 through July 19, 2012, and 0.47 ± 0.40 pCi/m^3 at the Sand Dunes station for the time period of March 1 through March 29, 2012.

All atmospheric tritium measurements for 2012 were less than one percent of the concentration for compliance with federal regulations (40 CFR 61). Tritium levels were at or near background levels at all locations.

Gaseous Radioiodine

No gaseous radioiodine was detected by DEQ-INL OP in 2012.

Precipitation

Tritium was detected in the third quarter composite precipitation samples at the following sampling locations: Monteview 0.16 nCi/L (MDC 0.13 nCi/L) and Big Lost River Rest Area 0.17 nCi/L (MDC 0.13 nCi/L). The results are well below the federal limit of 20,000 pCi/L (20 nCi/L) set by the EPA for drinking water. No manmade gamma-emitting radionuclides were detected by DEQ-INL OP 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-INL OP 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, agreement of paired samples is taken if the two sample results are within 20 percent of each other or if the difference between the results is within 3 standard deviations. Agreement between 80 percent 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.

During the third and fourth quarter of 2012 the TSP sampler located at the Mud Lake station experienced volume control issues which are detailed in the quality assurance section of this report. For 2012, gross alpha particle results agreed for 84 percent of the paired samples (**Table 2**).

Gross beta particle results for DEQ-INL OP were not in overall statistical agreement with those of ESER, or BEA (**Table 2**). 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 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-INL OP suspended particulate matter analysis results for paired samples with ESER and BEA results in 2012.

Sampling Agency	ESER Stoller[a]	BEA[b]
DEQ-INL OP Gross Alpha Analysis	84 %	84%
DEQ-INL OP Gross Beta Analysis	49 %	64 %

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by DOE contractor Gonzales-Stoller Surveillance, LLC (GSS)

b. BEA – Battelle Energy Alliance, INL prime contractor during 2012.

Comparing tritium sample results among DEQ-INL OP, 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 they are several orders of magnitude below minimum regulatory limits. Results from all three monitoring agencies indicate no public health risk.

Air Monitoring Impacts and Conclusions

Based upon 2012 air quality measurements, DEQ-INL OP 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.

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-INL OP air monitoring results agreed with the results obtained by DOE and its contractors either (1) by direct comparison or, (2) by the fact that all results 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 the residual radioactivity present in soil from historic above-ground testing of nuclear weapons and nuclear reactor operations. Radiological conditions on the INL and throughout the eastern Snake River Plain are continuously monitored by DEQ-INL OP. Penetrating radiation measurements are performed by DEQ-INL OP at each air monitoring station maintained by DEQ-INL OP, at meteorological towers maintained by the National Oceanic and Atmospheric Administration (NOAA), at background locations distant to the INL, and along roadways that bound or cross the INL (**Figure 6**). Radiation monitoring results obtained by DEQ-INL OP are compared with radiation monitoring results reported by the DOE and its INL contractors for these same locations to determine whether the data are comparable.

Radiation Monitoring Equipment and Procedures

Radiological conditions are monitored continuously via a network of 12 high-pressure ion chambers (HPICs) that provide "real-time" radiation exposure rates. One of these HPIC stations is owned and operated by the Shoshone-Bannock Tribes at Fort Hall, Idaho, and uses equipment identical to that used by DEQ-INL OP. Data are collected by DEQ-INL OP via radio telemetry and are available to the public at:

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

DEQ-INL OP also uses a network of passive electret ionization chambers (EICs) on and around the INL to cumulatively measure radiation exposure. These measurements are then used to calculate an average exposure rate for the quarterly monitoring period. The objectives of the DEQ-INL OP EIC network are to identify baseline levels (background radiation) to use for comparison in the event of an upset condition (accidental release of radioactive material), to assess dose and validate the dispersion model, and to verify contractor environmental gamma radiation data. **Figure 5** shows a DEQ-INL OP 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 2012, EIC and HPIC measurements performed at locations on INL were similar to those at off-site monitoring locations and were consistent with expected background exposures associated with natural cosmic and terrestrial sources.

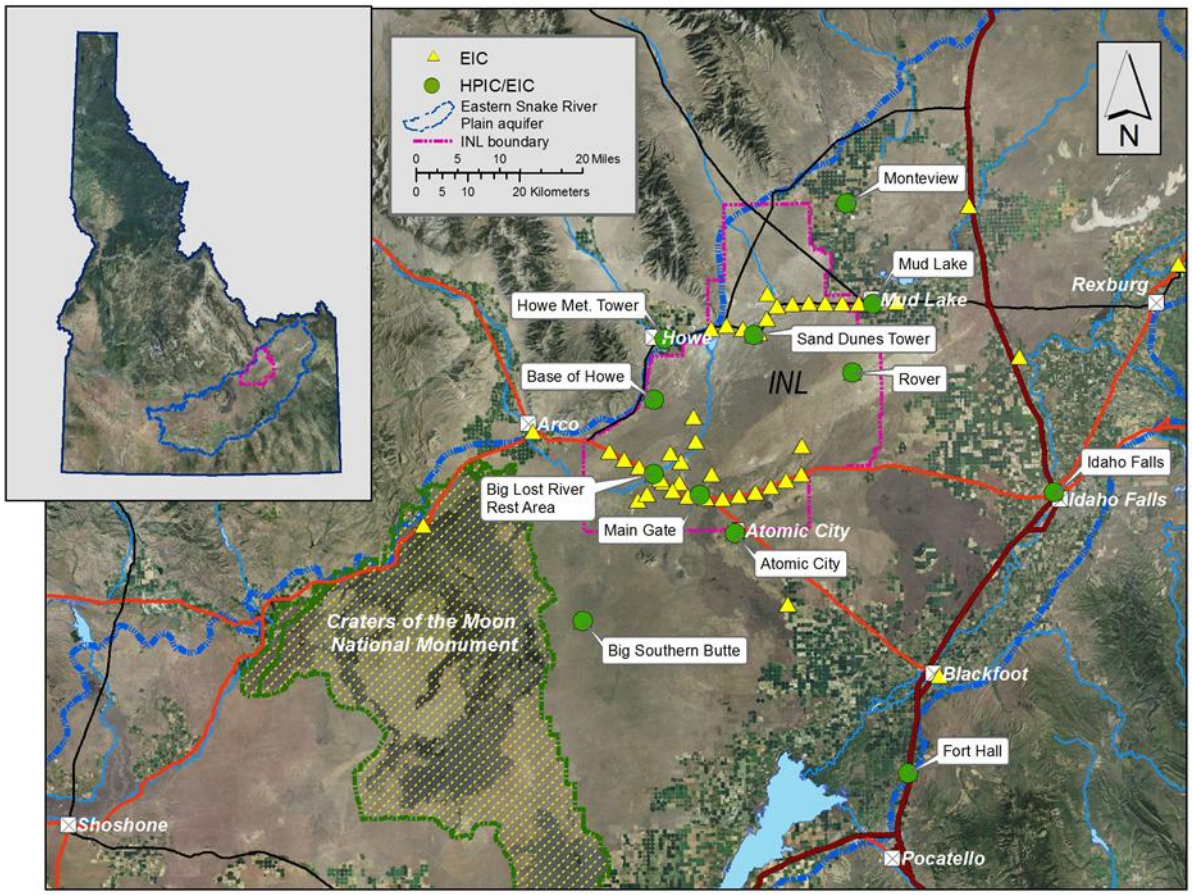


Figure 6. Locations of HPIC and EIC monitoring sites.

Radiation Monitoring Verification Results

DEQ-INL OP has placed several EICs at locations monitored by DOE contractors. DOE contractors use thermoluminescent dosimetry (TLD) for direct radiation measurements. Ambient penetrating radiation measurements during 2012 showed 90 percent of BEA's and 88 percent of ESER Gonzales-Stoller Surveillance, LLC (GSS)'s TLD measurements agreed statistically with co-located DEQ-INL OP EIC measurements (**Table 3**).

Table 3. Comparison of DEQ-INL OP, ESER and BEA radiation measurements at co-located sites in 2012. (Units in micro-Roentgen per hour or µR/h)

Statistical Measure	DEQ	ESER[a] GSS	DEQ	BEA[b]
Mean	12.2	14.4	12.4	14.4
Median	12.0	14.4	12.6	14.4
Standard Deviation	1.9	1.2	1.8	1.0
Minimum	9.0	12.5	9.0	12.6
Maximum	15.9	16.7	15.9	16.5
Average % difference		-17.0%		-16.2%

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by INL contractor Gonzales-Stoller Surveillance, LLC (GSS).
b. BEA – Battelle Energy Alliance, INL prime contractor during 2012.

Radiation Monitoring Impacts and Conclusions

Based upon radiation measurements made by DEQ-INL OP, there were no discernable impacts from INL operations in 2012. Measurements on the INL are comparable to those at background locations. Averaged real-time HPIC measurements met DEQ-INL OP criteria when compared quarterly with EIC dose rates in 2012.

Water Monitoring

During 2012, 74 water monitoring sites were sampled to aid in identifying INL impacts on the Eastern Snake River Plain Aquifer. Data collected from these monitoring sites were further examined to determine trends of INL contaminants and other general ground water quality indicators. Some data were also used to determine whether the monitoring results obtained by the DOE and its contractors were consistent with the sampling results obtained by DEQ-INL OP for these same locations.

Samples collected from water monitoring sites are analyzed for radiological and non-radiological constituents. Measuring these constituents helps to identify INL impacts to the aquifer. Many of these analytes occur naturally in ground water and surface water. Elevated concentrations are also present in certain areas of the aquifer, due to historic and ongoing INL operations. Key non-radiological analytes include various common ions, trace metals, and organic compounds. Radiological analyses focus on screening measurements and specific human-made or primarily human-made contaminants. These analytes include gross alpha and gross beta radioactivity, ^{137}Cs and other gamma-emitting radionuclides, and tritium. Selected sites are also sampled for ^{90}Sr, ^{99}Tc, ^{241}Am, ^{234}U (Uranium-234), ^{235}U (Uranium-235), ^{238}U (Uranium-238), ^{238}Pu, and $^{239/240}$Pu.

The types of sites sampled include ground water locations (wells and springs), surface water locations (streams), and selected wastewater locations from INL facilities. Sample sites are also categorized as up-gradient, facility, boundary, distant, surface water, or wastewater. Up-gradient locations are not impacted by INL operations, so they are considered representative of background ground water quality conditions. Facility locations are sample sites within the INL

that are near facilities, in areas of known contamination, or have been selected to illustrate trends for specific INL contaminants or indicators of ground water quality. Boundary locations are on or near the southern boundary of the INL or 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. Surface water and wastewater are monitored because they are current sources of recharge to the aquifer and have the potential to impact the aquifer. The water monitoring sites on and surrounding the INL are illustrated in **Figure 7** and **Figure 8**, showing the extent of the water monitoring program on the Snake River Plain.

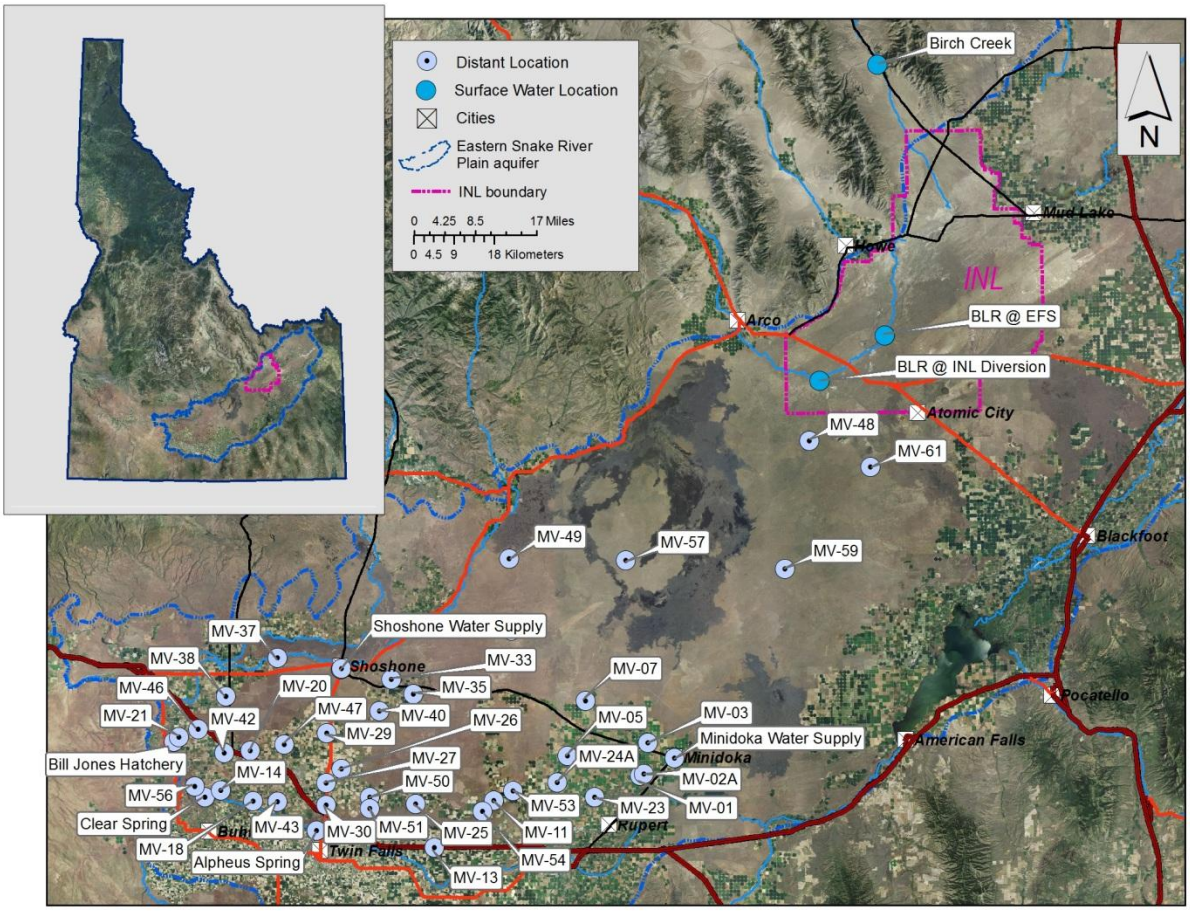


Figure 7. Water quality monitoring sites distant from the INL Site and surface water sites on Birch Creek and the Big Lost River (BLR).

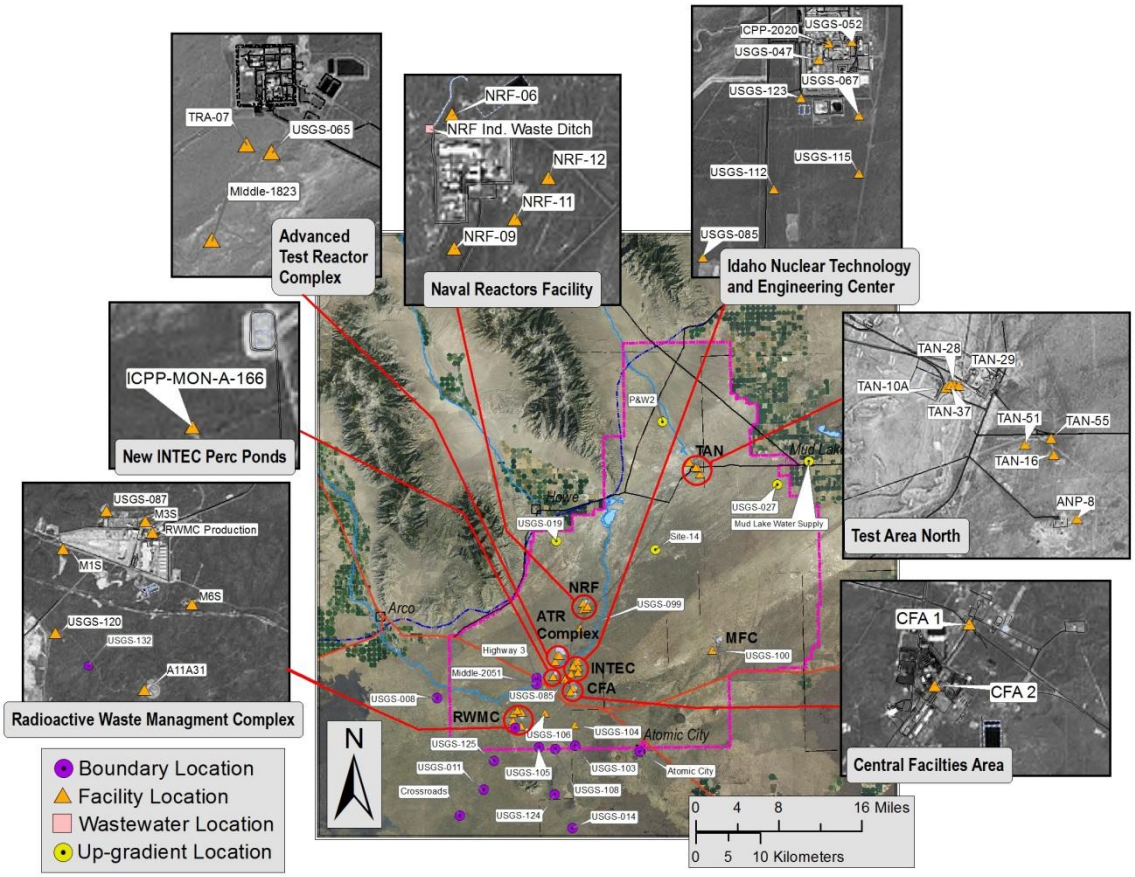


Figure 8. Water quality monitoring sites on and near the INL Site.

Water Monitoring Equipment and Procedures

Most ground water samples were collected from wells equipped with submersible pumps and concurrent with sampling by the DOE Contractors USGS and CWI. Surface water samples were typically collected as grab samples from the water source. Water samples are collected, handled and preserved using standard methods (**Figures 9 and 10**).

Sample analyses for non-radiological analytes were conducted by the Idaho Bureau of Laboratories in Boise or their subcontractor(s). Radiological analyses were performed by ISU-EML or its subcontractor(s). Analysis methods used were consistent with industry standards.

Samples from all monitoring locations were analyzed for gross alpha and gross beta radioactivity, for gamma-emitting radionuclides (by gamma spectroscopy), and for tritium. Selected sites with historic INL contamination were also sampled for ^{90}Sr, ^{99}Tc, and other site-specific analytes including ^{234}U, ^{235}U, and ^{238}U, ^{238}Pu, and $^{239/240}$Pu and ^{241}Am. Samples were collected from monitoring sites for analysis of non-radiological parameters including common ions (calcium, magnesium, sodium, potassium, chloride, fluoride, sulfate, and total alkalinity), nutrients (total nitrate plus nitrite and total phosphorus), and trace metals (arsenic, barium, chromium, iron, manganese, lead, selenium, and zinc).

Figure 9. Measuring depth to ground water with a USGS staff member.

Figure 10. Collecting ground water samples from a monitoring well.

Water Monitoring Results and Trends

A summary of the ranges of analyte concentrations observed for up-gradient, facility, boundary, distant, and surface water monitoring sites is presented here along with their respective primary drinking water standard when applicable. National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Maximum Contaminant Levels (MCL's) are the highest level of a contaminant that is allowed in drinking water. Secondary Drinking Water Regulations or secondary maximum contaminant levels (SMCL's) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. Also, analytical results from several sample locations are highlighted and examined more closely to identify current trends. Results for all DEQ-INL OP environmental surveillance are available in quarterly data reports on the DEQ Web site at http://www.deq.idaho.gov/inl-oversight/monitoring/reports.aspx.

Radiological Analytes

Gross alpha and gross beta analyses measure total alpha and beta radioactivity particles in a sample. Radionuclide contributors to both gross alpha and gross beta radioactivity can occur naturally, as well as due to historic INL operations. These analyses do not differentiate among the types of radionuclides present in a sample of water, but are fast and relatively inexpensive. Therefore, the gross alpha and gross beta radioactivity analyses are especially useful to screen large numbers of samples for the possible presence of radionuclides at levels above naturally occurring radioactive concentrations.

The primary natural sources of gross alpha radioactivity in ground water and surface water are naturally occurring uranium and thorium. The gross alpha radioactivity observed in most facility, boundary, distant, and surface water sites is due to natural sources. Some facility sites do show gross alpha radioactivity from INL sources. This is apparent not only because concentrations are above background, but other human-made contaminants are also detectable. The highest concentration for DEQ-INL OP sampled sites was from a facility site, TAN-28 (**Table 4**). The INL contractor responsible for monitoring at TAN-28 attributes the elevated gross alpha radioactivity to historic disposal of wastes that included ^{234}U. A summary of this and other radiological results from water monitoring is shown in **Table 4**.

Select locations are sampled for uranium and plutonium isotopes. In 2012, uranium isotope results were not differentiable from natural background ranges. ^{238}Pu, $^{239/240}$Pu, and ^{241}Am were not detected in 2012.

Table 4. Summary of selected radiological analytical results for DEQ-INL OP 2012 water samples, wastewater excluded.

Analyte (pCi/L)[1]	Facility			Up-gradient, Boundary, Distant, and Surface Water			Back-ground[2]	Drinking Water Standard[3]
	Min	Median	Max	Min	Median	Max		
Gross Alpha	<MDC[4]	<MDC	13.6 ± 3.9	<MDC	<MDC	3.4 ± 1.1	0-3	15
Gross Beta	<MDC	4.4	703.4 ± 10.5	<MDC	3.4	8.6 ± 1.2	0-7	50
^{137}Cs	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	0	200
Tritium	<MDC	610	7960 ± 230	<MDC	<MDC	290 ± 90	0-40	20,000
^{90}Sr	<MDC	<MDC	261 ± 61	NS[5]	NS	NS	0	8
^{99}Tc	0.5±0.1	1.3	408.3 ± 1.9	NS	NS	NS	0	900

[1] pCi/L – picocuries per liter.
[2] Background concentrations for the Snake River Plain Aquifer.
[3] The federal drinking water standard is expressed as a cumulative annual dose of 4 millirem/year. This value was converted to a specific concentration for each analyte and reflects that analyte's maximum contaminant level (MCL).
[4] MDC is the minimum detectable concentration.
[5] NS – Not Sampled.

Sources of naturally occurring gross beta radioactivity include radioactive ^{40}K, (potassium-40), as well as radioisotopes that were produced from the decay of natural uranium and thorium. Several locations on the INL have gross beta levels that exceed those observed from natural sources in the Eastern Snake River Plain Aquifer. The highest concentration of gross beta radioactivity was measured at a facility site, TAN-37 (**Table 4**). The observed gross beta radioactivity at this well can be accounted for by the measured ^{90}Sr, discussed following and seen in **Figure 13**.

^{137}Cs (Cesium-137) is a known ground water contaminant for both the TAN area and INTEC area and has been detected previously. For 2012, however, ^{137}Cs was not detected in any samples.

Monitoring samples were analyzed for additional human-made contaminants such as tritium, ^{90}Sr, and ^{99}Tc and most results were consistent with concentrations measured in previous years. In the following sections, the results for tritium, ^{90}Sr, and ^{99}Tc are discussed.

Tritium

Most of the radioactivity released to the aquifer was in the form of tritium from spent nuclear fuel reprocessing operations at the Idaho Nuclear Technology and Engineering Center (INTEC) and reactor operations at the Advanced Test Reactor Complex (ATR Complex). At INTEC, tritium was disposed in the aquifer by injection well and later by percolation ponds. Waste pond operations that allowed tritium to infiltrate to the aquifer ceased in 1995 at INTEC and in 1993 at ATR Complex. Tritium concentrations for selected wells with INL contamination near INTEC and ATR Complex are presented in **Figure 11** (see **Figure 8** for well locations). The tritium concentrations found in these wells have continued to decline because tritium is no longer disposed directly to the aquifer. Over time, the tritium contamination has undergone radioactive decay and has been diluted in the aquifer. Historic levels had previously exceeded the maximum contaminant level (MCL) of 20,000 picocuries per liter (pCi/L) for many of these sites.

The concentration of tritium in wells near RWMC has also declined since about 1998, and is generally much lower than in wells near INTEC and ATR Complex. The primary source of tritium observed in wells at the RWMC is likely from wastes disposed at that facility, although up-gradient tritium sources at ATR Complex and possibly INTEC may also contribute to the ground water contamination. Tritium concentrations greater than background have been measured in wells approximately 4 miles past the INL southern boundary using a low-level tritium analysis which has a lower MDC (10 to 14 pCi/L). **Figure 12** shows tritium concentrations measured in 2012.

Westbay™ packer sampling systems have been installed by the USGS and DOE Contractor in selected wells along the INL southern boundary. These multi-level sampling systems contain multiple sampling ports that are each isolated by permanent packer systems which allow water samples to be collected from discrete levels or zones within the well. Each zone is selected based on measured aquifer properties, and these zones are correlated to aquifer zones identified in previous USGS investigations and modeling efforts. By sampling at multiple levels in the aquifer a better understanding of the vertical distribution of wastewater constituents in the aquifer is provided. In 2012, five Westbay wells were sampled, including USGS-103 (at 1258.0 ftbls, or feet below land surface), USGS-105 (at 1069.6 ftbls), USGS-108 (at 887.7 ftbls), USGS-132 (at 765.4 ftbls) and Middle-2051 (at 1091.1 ftbls). Sample results indicate the presence of tritium related to INL waste disposal influences.

For more information concerning USGS wells at the INL with Westbay™ multilevel sampling systems see "Chemical Constituents in Groundwater from Multiple Zones In the Eastern Snake River Plain Aquifer at the Idaho National Laboratory, Idaho, 2005-2008" (http://pubs.usgs.gov/sir/2010/5116/).

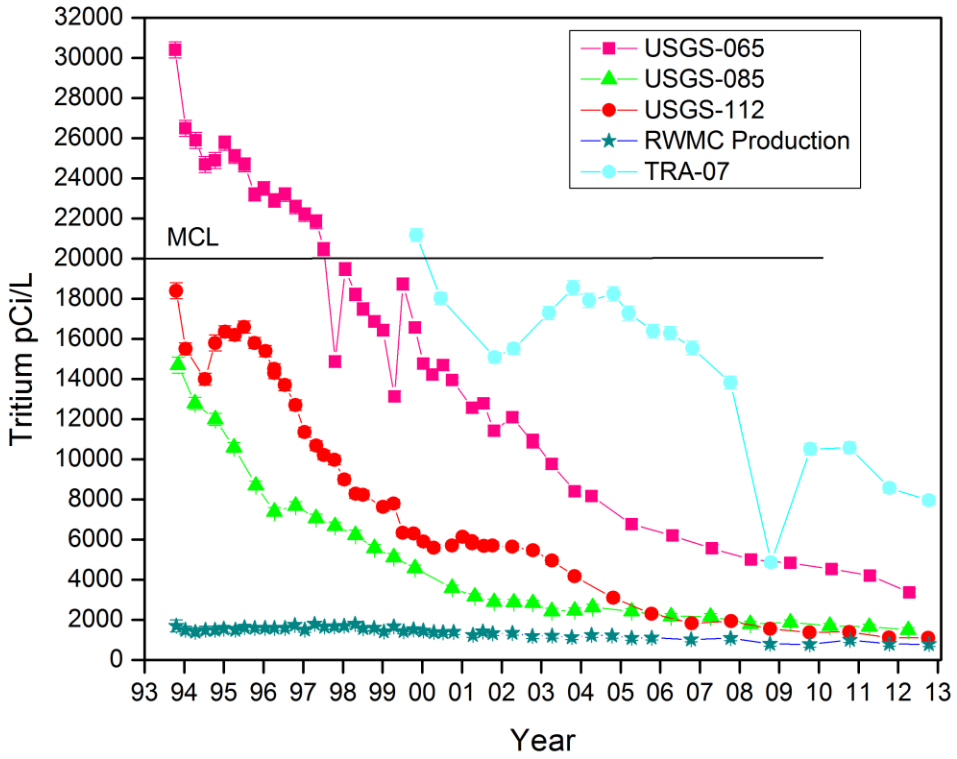


Figure 11. Tritium concentrations (pCi/L) over time for selected INL Site wells impacted by INL contamination.

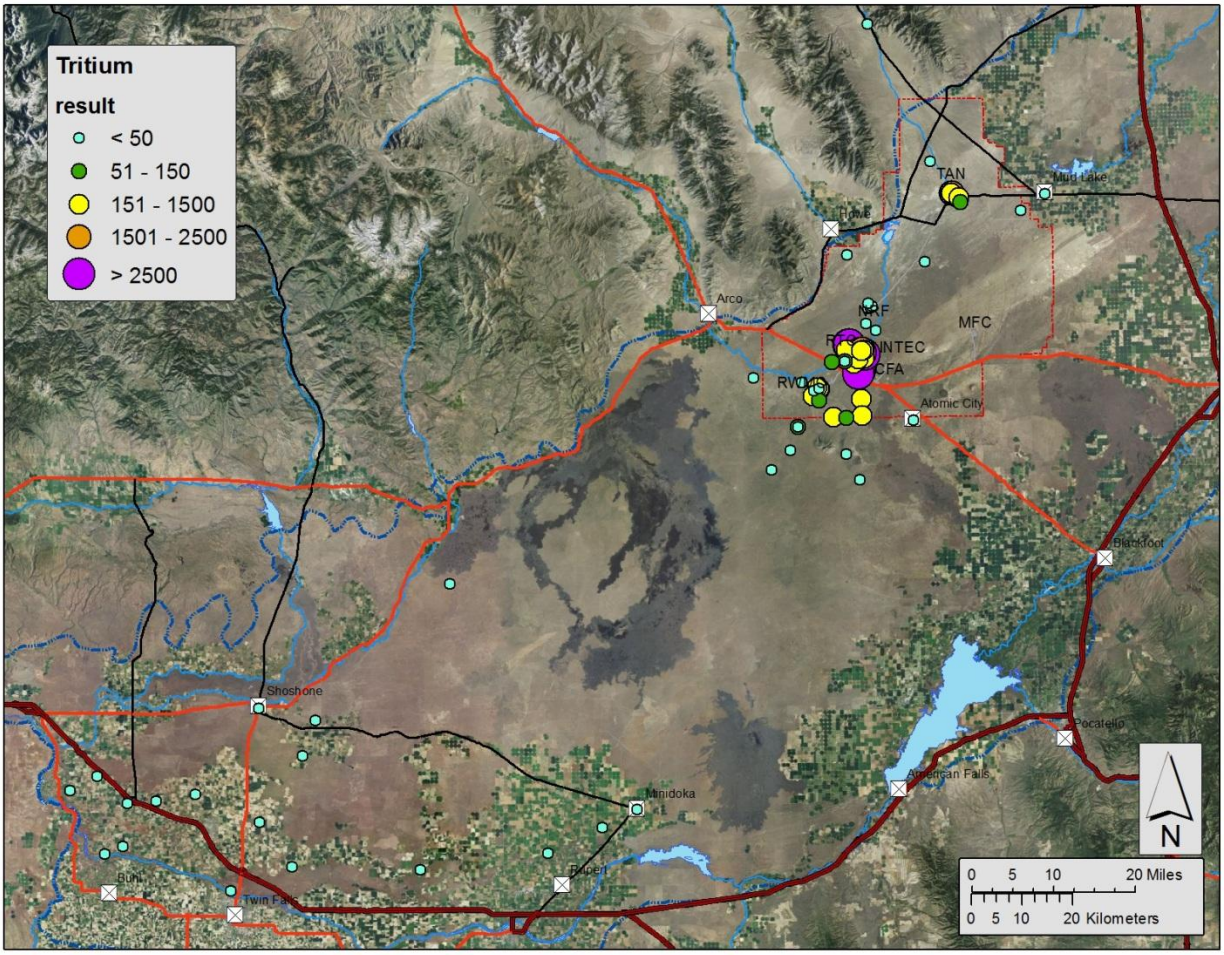


Figure 12. 2012 tritium concentrations (pCi/L) for DEQ-INL OP sample locations.

Strontium-90

^{90}Sr and ^{99}Tc are the primary sources of the elevated gross beta radioactivity observed in wells with INL contamination. Concentrations of ^{90}Sr found in the aquifer remain relatively constant for selected wells near the Test Area North (TAN) facility with one exception. Monitoring well TAN-37 had the highest ^{90}Sr concentration during 2010 and 2011, however, the 2012 concentration of 261 ± 61 pCi/L shows a large drop from the concentration measured the previous year, 580 ± 140 pCi/L. The 2012 gross beta concentration for TAN-37 also shows a significant drop from 2011, 703.4 ± 10.5 pCi/L versus 1312.1 ± 13.6 pCi/L respectively. This is consistent with the 2012 ^{90}Sr data for TAN-37. DEQ-INL OP and contractor gross beta data for this particular well (contractor and DEQ-INL OP samples were collected roughly a month apart) are similar. DEQ-INL OP initially sampled TAN-37 in 1999. This well is located near the TAN waste injection well (used from 1953-1972), and in the region of ongoing aquifer treatment for volatile organic compounds (VOCs) in the ground water. Concentrations of ^{90}Sr for other wells located near TAN have remained relatively consistent since DEQ-INL OP first sampled these sites in 2003 (**Figure 13**). At INTEC, ^{90}Sr is thought to have been released due to historic waste injection at INTEC and more recently from leaks and spills associated with the INTEC Tank Farm Facility. **Figure 14** illustrates ^{90}Sr concentrations for wells located at or down gradient of INTEC, including, USGS-047, USGS-067, USGS-085 and USGS-112. ^{90}Sr concentrations at all

sites have been declining or holding steady. **Figure 14** also shows USGS-055, a perched aquifer well near the historic warm waste ponds located adjacent to the ATR Complex. ^{90}Sr concentrations near the ATR Complex are due to past disposal practices. USGS-055 is a perched water well and has not been sampled by the DEQ-INL OP since 2009 due to lack of water. **Figure 15** shows ^{90}Sr concentrations at DEQ-INL OP sample locations during the 2012 monitoring season.

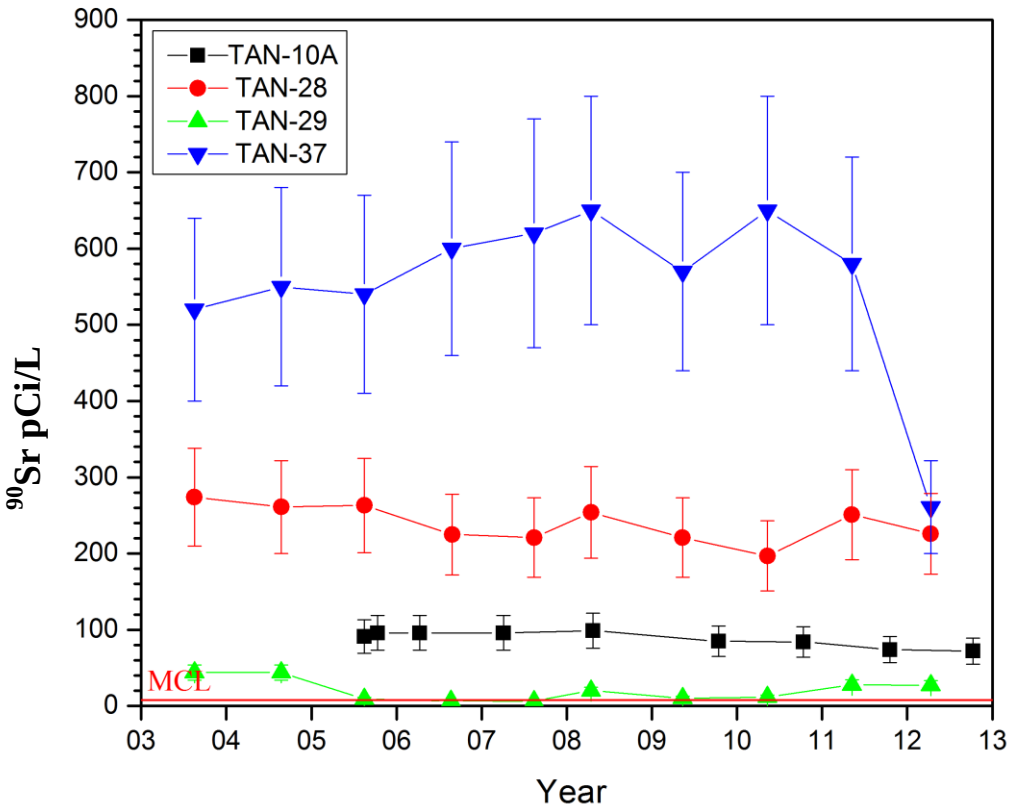


Figure 13. ^{90}Sr concentrations over time for selected wells near Test Area North (TAN).

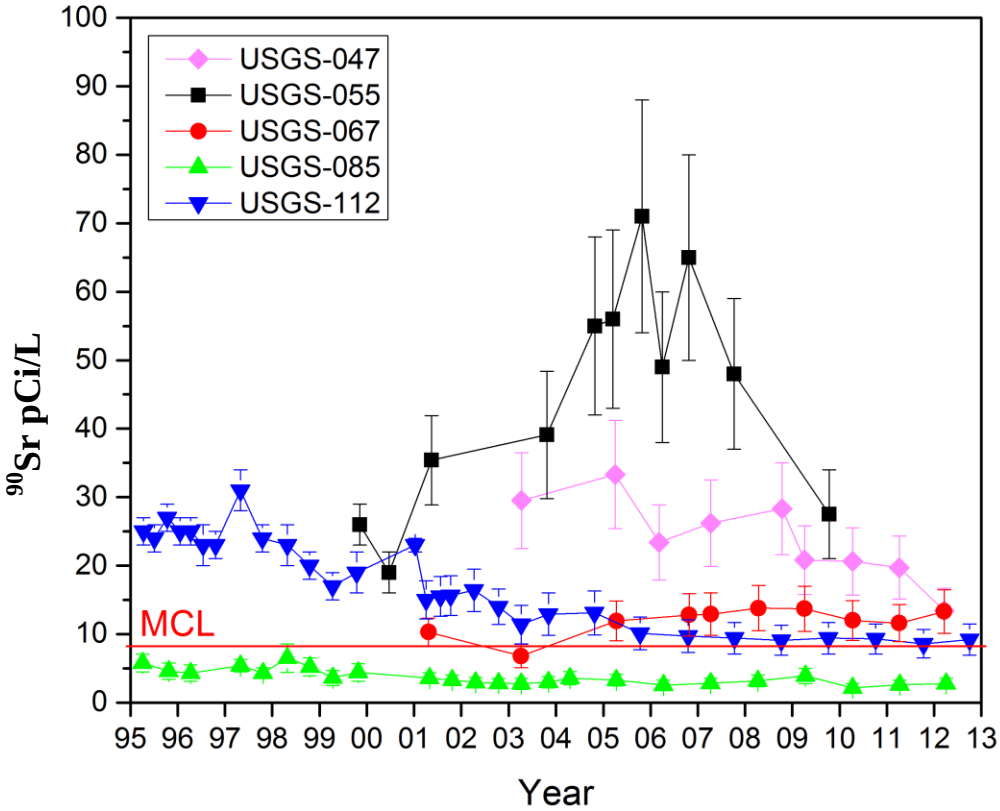


Figure 14. ^{90}Sr concentrations over time for selected INL Site wells impacted by INL contamination.

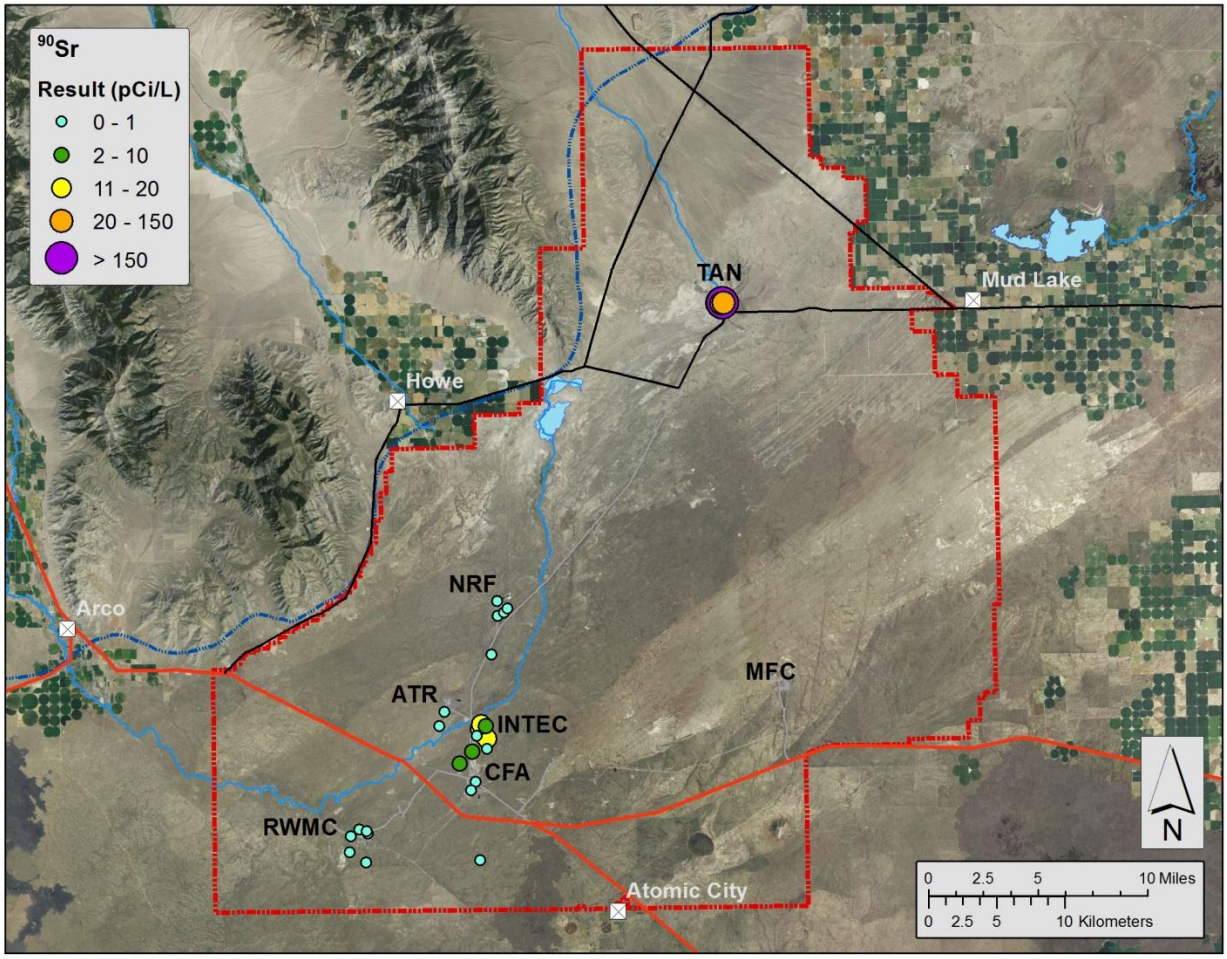


Figure 15. 2012 ^{90}Sr concentrations (pCi/L) for DEQ-INL OP sample locations.

Technetium-99

^{99}Tc is thought to have been released due to historic waste injection at INTEC and more recently from leaks and spills associated with the INTEC Tank Farm Facility. The greatest concentration observed for DEQ-INL OP monitored sites in 2012 was for well USGS-052 (408.3 ± 1.9 pCi/L), located at INTEC. **Figure 16** shows ^{99}Tc concentrations over time for selected INL wells located near or down gradient of INTEC. Concentrations of ^{99}Tc at four of these wells, including CFA-1, USGS-047, USGS-112, and USGS-115 appear to be constant over the past several years. Other wells represented in **Figure 16** include USGS-052, USGS-067 and ICPP-2020. Results for USGS-067 show an initial increase in concentration from 2000 to 2004; however, the concentration has been steady over the last few years with minor fluctuation. Results for USGS-052 vary annually with concentrations fluctuating 5-20 percent between sampling events. This site will continue to be evaluated. The final well includes ICPP-2020, which is located near USGS-052. DEQ-INL OP began monitoring ICPP-2020 in 2009 and all four samples collected so far have produced steadily declining concentrations of ^{99}Tc. All 2012 results for ^{99}Tc were below the MCL of 900 pCi/L. **Figure 17** shows ^{99}Tc concentrations at DEQ-INL OP sample locations.

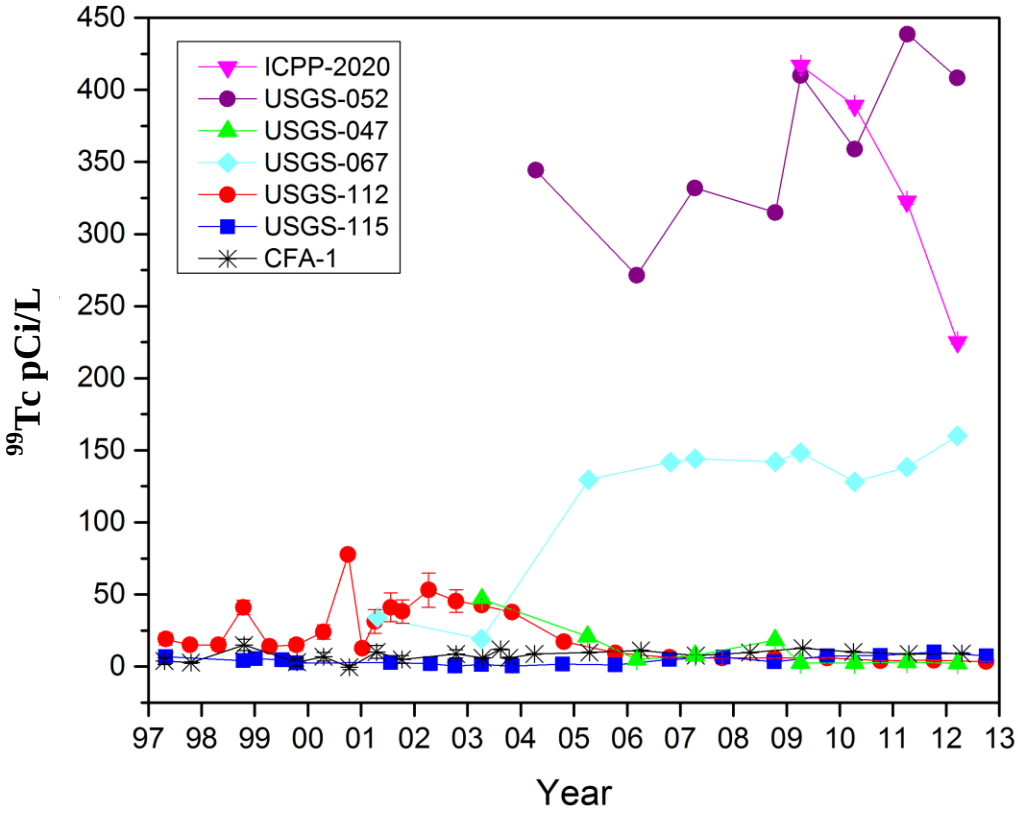


Figure 16. ^{99}Tc concentrations over time for selected INL Site wells impacted by INL contamination.

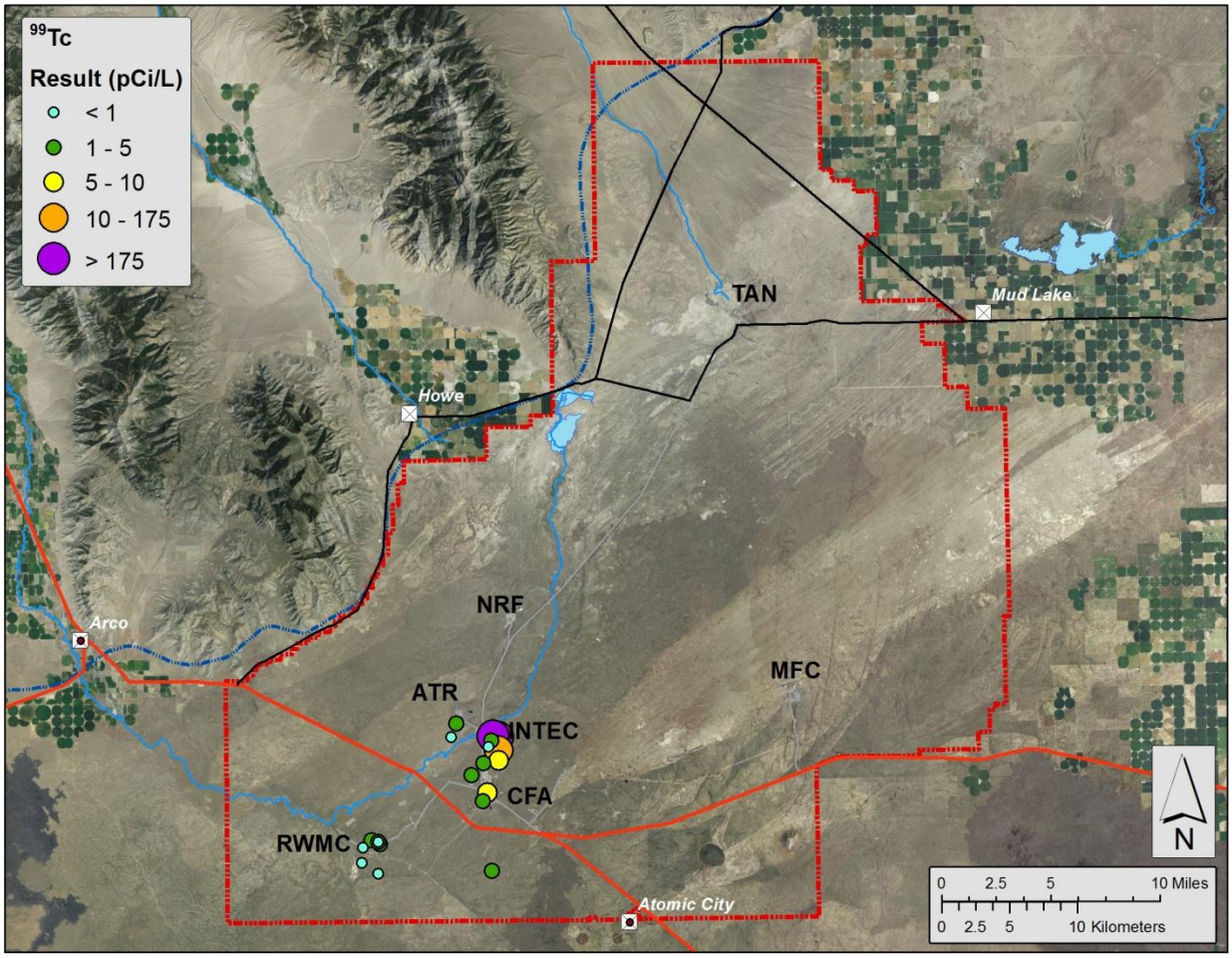


Figure 17. 2012 ^{99}Tc concentrations (pCi/L) for DEQ-INL OP sample locations.

Non-radiological Analytes

Common ions, nutrients, and metals comprise all the dissolved constituents in natural ground water. These constituents also comprise nearly all the chemical wastes disposed to surface water or ground water as a result of past INL waste disposal practices. Concentrations for most analytes measured in 2012 were relatively unchanged from previous years. Common ions, nutrients, and metals results found in samples collected by DEQ-INL OP in 2012 are summarized in **Table 5**. Following the table is a discussion of analytical results for chloride, chromium, manganese and VOCs, which have each exceeded their respective drinking water standards either in the recent past or during the 2012 monitoring season.

Table 5. Summary of selected non-radiological analytical results for DEQ-INL OP water samples for 2012.

Analyte	Up-gradient			Facility			Boundary			Distant			Back-ground[1]	Drinking water standard[2]
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max		
Common Ions/Nutrients (mg/L)														
Calcium	8.3	37	51	26	47	160	37	39	45	26	44.5	72	5 - 43	none
Magnesium	2.5	14.5	19	12	15.5	41	11	15	18	13	17	28	1 – 15	none
Sodium	7.0	14	30	8.4	14.5	190	6.0	8.8	17	7.8	21	44	5 – 14	none
Potassium	1.3	2.9	6.0	1.8	2.8	6.6	1.8	2.5	2.9	2.2	3.7	6.9	1 – 3	none
Chloride	5.66	10.6	49.7	8.4	21.3	580	6.7	13.6	22.0	4.4	26.1	69.4	2 – 16	250*
Sulfate	7.66	23.6	39.4	15.8	29.8	162	20.6	24.1	26.5	18.2	39.6	78.4	2 – 24	250*
Total Nitrate plus Nitrite	0.023	0.62	2.6	<DL[3]	1.1	5.6	0.45	0.76	1.3	<DL	1.55	5.1	1– 2	10
Total Phosphorus	0.011	0.019	0.034	0.012	0.029	0.18	0.017	0.021	0.028	0.021	0.029	0.061	<0.02	none
Metals (µg/L)														
Barium	20	63	81	22	50	260	23	40	77	14	36	100	50 – 70	2000
Chromium	<DL	5.1	5.3	<DL	12.5	89	<DL	<DL	8.4	<DL	<DL	<DL	2 – 3	100
Lead	<DL	<DL	20	<DL	<DL	6.6	<DL	<DL	<DL	<DL	<DL	<DL	<5	15
Manganese	<DL	<DL	14	<DL	<DL	940	<DL	<DL	14	<DL	<DL	2.4	<1– 4	50*
Zinc	<DL	<DL	<DL	<DL	<DL	670	<DL	18	180	<DL	9.9	270	<10	5000*

[1] Background concentrations for the Snake River Plain Aquifer. Depending on local geology, concentrations for sites not impacted by INL may be higher than the given background ranges.

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

[3] Detection Level

Chloride

Chloride concentrations in ground water are often elevated in regions impacted by agriculture due to the evaporation of infiltrating irrigation water. At the INL, large quantities of chloride have been discharged in the wastewater. The primary source of chloride in INL wastewater includes the use of sodium chloride (salt) to regenerate water softeners. DEQ-INL OP currently monitors only one well that has chloride concentrations which historically exceed the secondary maximum contaminant level (SMCL) of 250 mg/L. Results for NRF-06 are illustrated in **Figure 18**. NRF-06 is located near the NRF industrial waste ditch in which wastewater from water softeners is discharged. Chloride concentrations for DEQ-INL OP 2012 sample locations are shown in **Figure 19**.

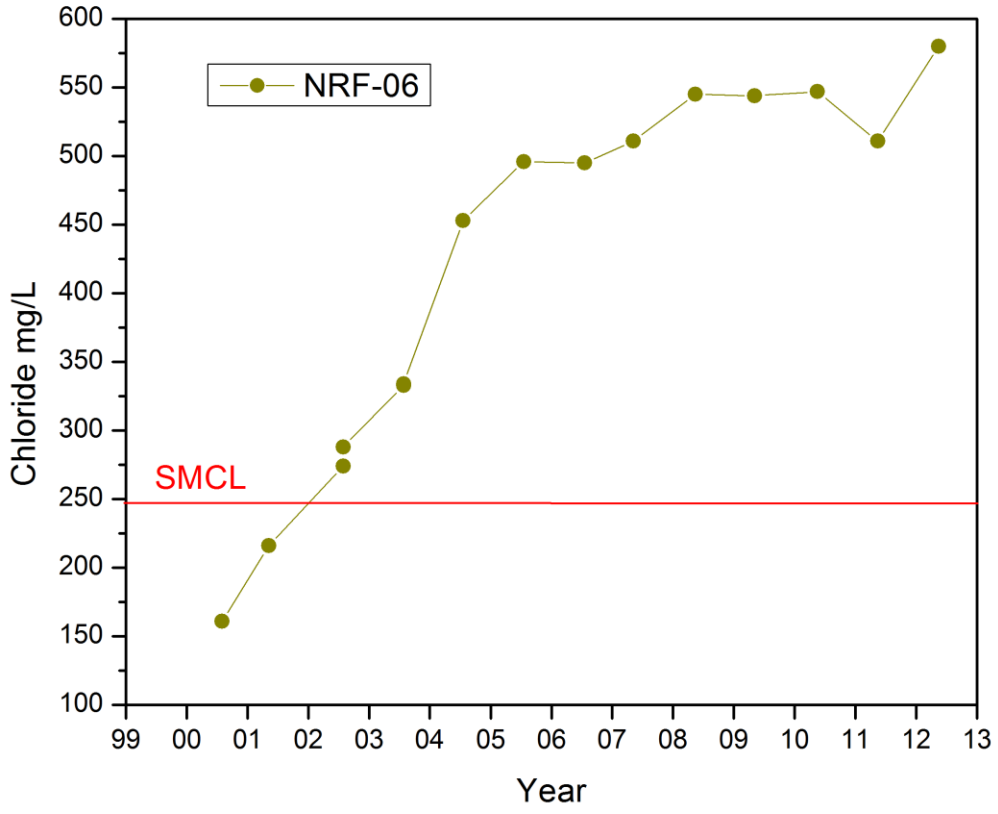


Figure 18. Chloride concentrations for sample location NRF-06 over time.

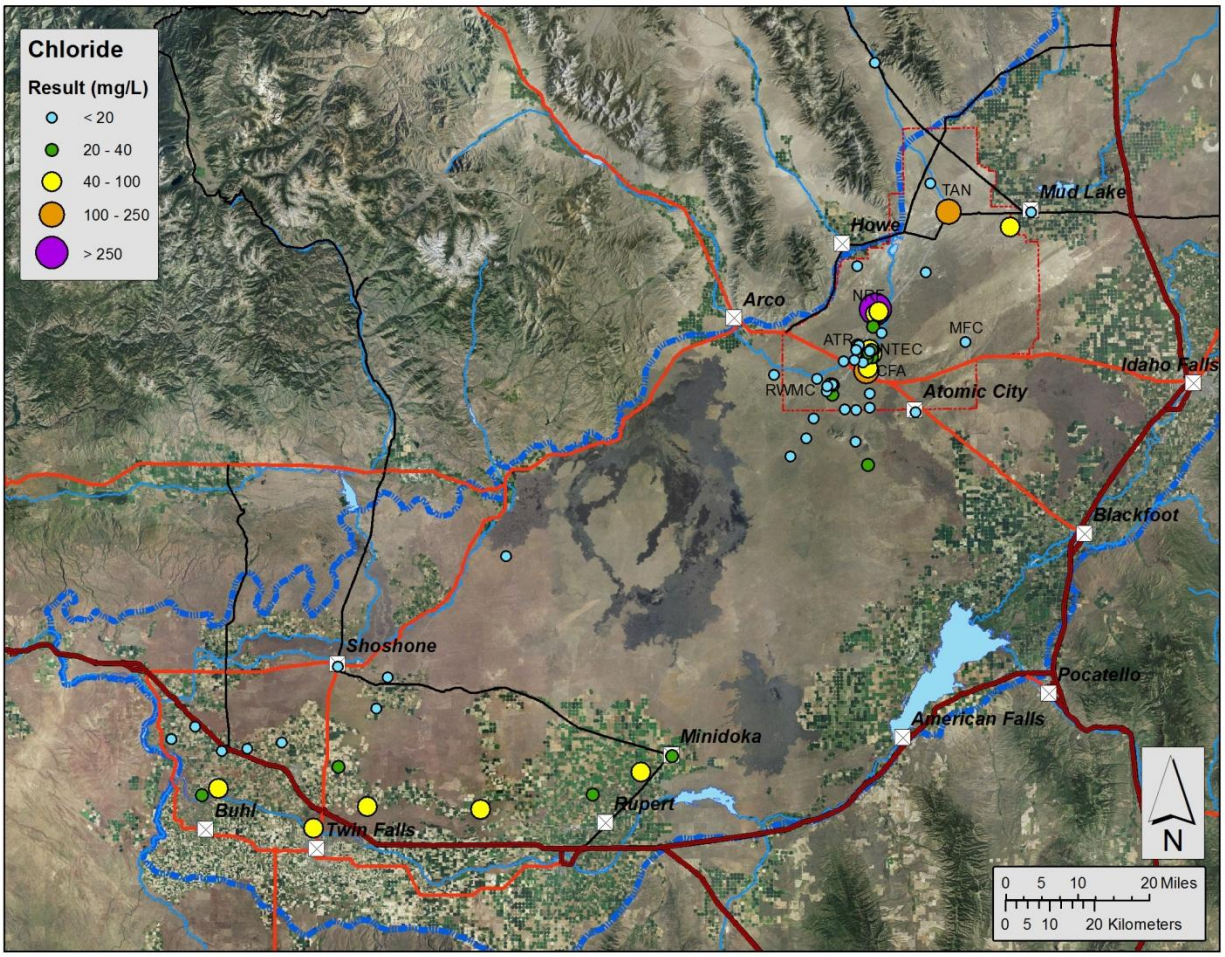


Figure 19. 2012 chloride concentrations for DEQ-INL OP sample locations.

Chromium

Chromium was used at the INL to prevent corrosion in industrial water systems until the early 1970s. Disposal practices at that time allowed chromium-contaminated water to enter groundwater either from injection wells or to percolate down through open disposal ponds and ditches. For this reason, chromium is observed at some INL ground water sampling sites. During 2012 chromium concentrations were below the maximum contaminant level (MCL) of 100 µg/L at all DEQ-INL OP monitored sites. This is a change from 2011 where two sites had concentrations above the MCL, including the sampling locations ICPP-2020 (320 µg/L), and TRA-07 (120 µg/L). Data for both wells are illustrated in **Figure 20** along with USGS-065 which has historically had chromium concentrations above or just below the MCL. TRA-07 and USGS-065 are located near the ATR Complex and have historically had elevated concentrations of chromium with a declining trend over time, as shown in **Figure 20**. ICPP-2020 is located at INTEC and has been sampled by the DEQ-INL OP since 2009, producing four samples. So far the results demonstrate large fluctuations in chromium concentration between each of the four samples. More data is needed to determine if there is a developing trend. Concentrations for DEQ-INL OP 2012 sample locations are shown in **Figure 21**.

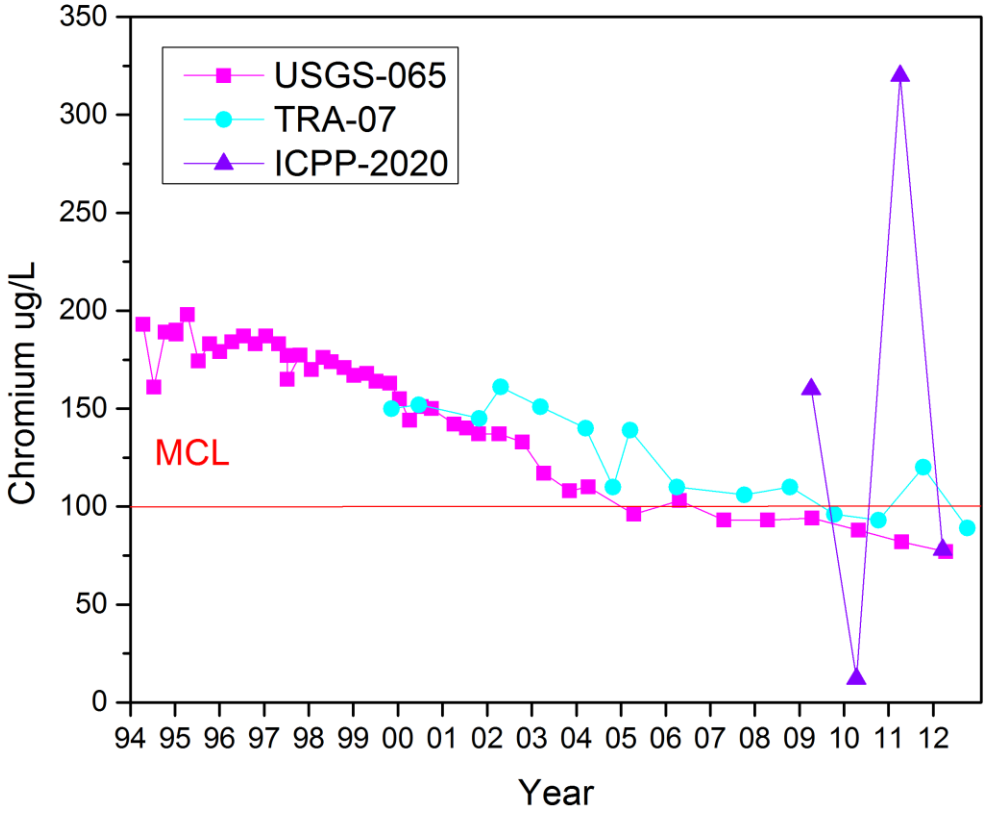


Figure 20. Chromium concentrations (µg/L) over time for selected INL Site wells impacted by INL contamination.

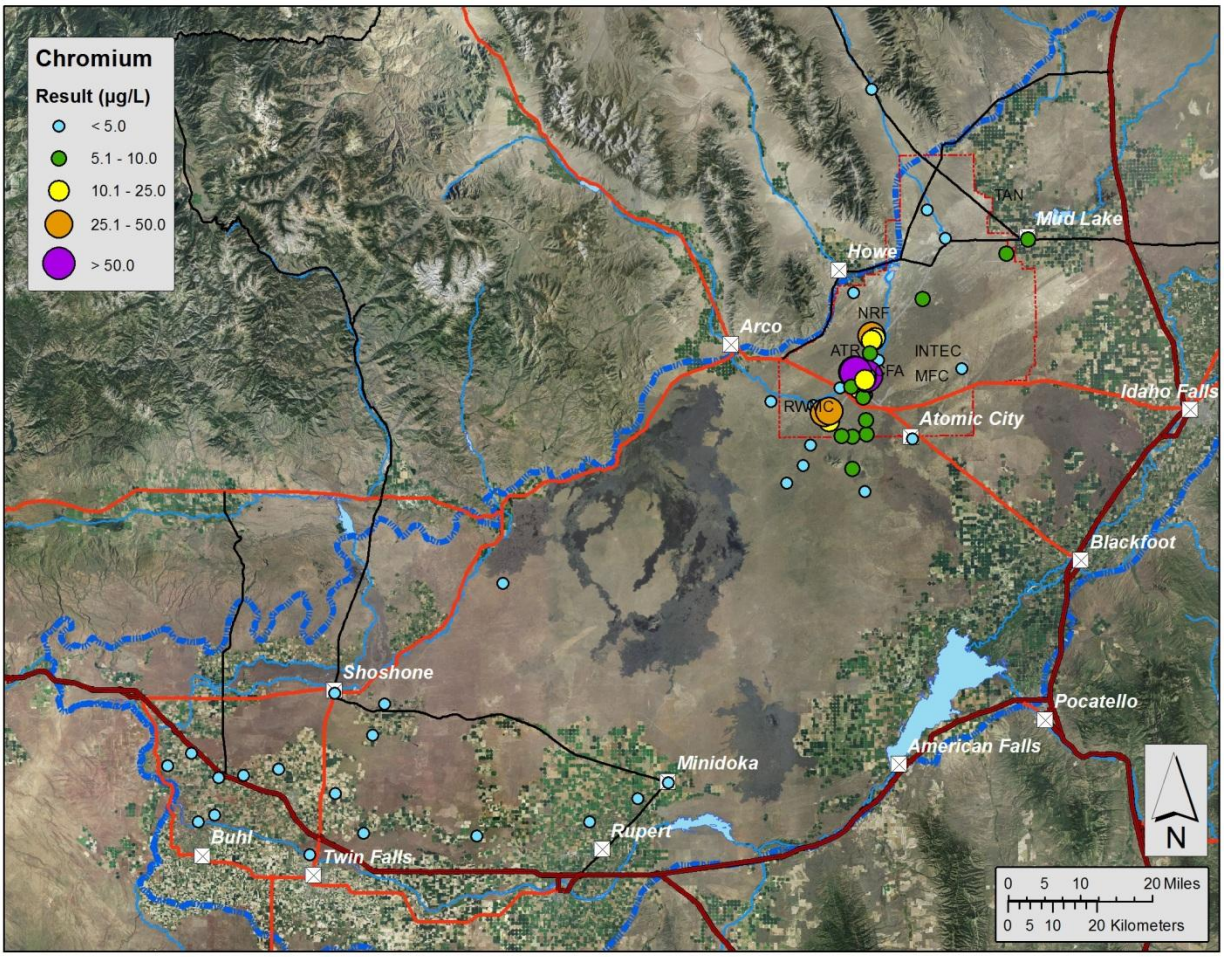


Figure 21. 2012 chromium concentrations (µg/L) for DEQ-INL OP sample locations.

Manganese

One well, TAN-10A, near the TAN facility has exceeded the SMCL for manganese (50 µg/L) since 2004. In 2012 DEQ-INL OP monitoring results for TAN-10A recorded a manganese concentration of (940 µg/L) which is comparable with historical values at this location. This concentration is consistent with conditions created by ongoing in-situ bioremediation efforts as part of the clean-up action for VOCs at TAN.

Volatile Organic Compounds

Concentrations of three VOCs continue to exceed MCLs in some wells at TAN: Tetrachloroethylene (or PERC, MCL = 5 µg/L), trichloroethylene (or TCE, MCL = 5 µg/L), and trans-1,2-dichloroethene (or DCE, MCL = 100 µg/L). Clean-up actions involving natural attenuation and bioremediation on ground water at TAN have been put on hold for the next three years to determine how concentrations of VOCs respond. These actions are in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Concentrations of two VOCs approach or exceed MCLs for wells at the RWMC; Carbon tetrachloride (MCL= 5 µg/L), and trichloroethylene (MCL= 5 µg/L). The 2012 sample results for specific wells can be found in the quarterly reports published on our Web site: http://www.deq.idaho.gov/inl-oversight/monitoring/reports.aspx.

Water Monitoring Verification Results

DEQ-INL OP collects water samples at the same time and location (co-sampled) with DOE or its contractors and verifies that its monitoring results are consistent with those obtained by DOE. In the event that a significant difference is found between DEQ-INL OP sample results and those of DOE, each sampling contractor's result is scrutinized individually to ascertain the cause of the difference. Some differences between results are expected due to factors that include natural variability in the media being sampled, random errors in the measurements, and systematic differences in how the samples are collected, handled and analyzed. The DEQ-INL OP verification sampling program is designed to co-sample at approximately 10% of all DOE sample locations for selected analytes. Co-sampled DEQ-INL OP results for 2012 were compared to the results obtained by DOE, both on an individual analyte-by-analyte comparison for each sample pair and on an overall sample average basis.

Radiological

A summary of the analyte-by-analyte comparison for each sample pair of DEQ-INL OP and DOE radiological results is presented in **Table 6**. Analyte-by-analyte comparisons showed that results were generally in very good agreement, with all compared analyses meeting our goal of 80 percent of results meeting comparison criteria.

Table 6. Radiological results for co-samples collected by DOE and DEQ-INL OP in 2012.

Analyte	Number of Co-sampled pairs in 2012	Percent of Co-sampled pairs passing criteria in 2012
^{241}Am	8	100
Gross Alpha	45	96
Gross Beta	45	93
^{137}Cs	36	100
^{238}Pu	12	100
$^{239/240}$Pu	12	100
^{90}Sr	18	94
^{99}Tc	12	92
Tritium	61	100
^{234}U	13	100
^{235}U	14	100
^{238}U	13	100

Non-Radiological

A summary of the analyte-by-analyte comparison for each sample pair of DEQ-INL OP and DOE non-radiological results for 2012 is presented in **Table 7**. Analyte-by-analyte comparisons showed that over 80 percent of results for all analytes except VOCs met our goals for agreement. The largest differences noted were in the analyses of manganese and VOCs. The reason for VOC co-sampled pairs failing to meet at least 80 percent comparison criteria is still under investigation; however, there were a number of co-sampled pairs in which the results were qualified as estimated values possibly influencing comparison criteria.

Table 7. Non-radiological results for co-samples collected by DOE and DEQ-INL OP in 2012.

Analyte	Number of Co-sampled pairs in 2012	Percent of Co-sampled pairs passing criteria in 2012
Common Ions/Nutrients		
Calcium	17	100
Magnesium	17	100
Sodium	47	100
Potassium	17	88
Chloride	54	93
Sulfate	47	98
Total Nitrate plus Nitrite	50	92
Trace Metals		
Barium	17	100
Chromium	36	100
Lead	19	95
Manganese	19	84
Zinc	14	93
VOCs[1]	79	73

[1]114 co-sampled VOC samples were collected and 79 paired results for the same analytes were compared.

Water Monitoring and Verification Impacts and Conclusions

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

- Concentrations for ^{90}Sr, chloride, manganese and VOCs exceeded federal drinking water standards (MCLs or SMCLs) at some sites on the INL in 2012. These sites, however, are not used for drinking water.
- No sites monitored exceed federal drinking water standards for tritium. Concentration trends for tritium continue to decline. This INL contaminant is detectable at monitoring sites beyond the INL boundary at levels just higher than local background concentrations.
- Concentrations for other INL contaminants in water continue to decrease at most locations as a result of changes in waste disposal practices. Chromium concentrations at ICPP-2020 and TRA-07 exceeded the MCL in 2011, but fell below the MCL in 2012. While results for both sites display variability, chromium concentrations at ICPP-2020 range over 2 orders of magnitude. Additional analysis is needed of samples from ICPP-2020 to understand the reason for this extreme fluctuation.
- INL impacts to the aquifer are not identifiable in water samples collected from 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 detect the presence or absence of atmospheric radioiodine deposited in the terrestrial environment or in the regional food supply. Some of these data are also used to verify the monitoring results obtained by the DOE and its contractors.

Terrestrial Monitoring Equipment and Procedures

DEQ-INL OP uses a combination of *in-situ* gamma spectrometry and physical soil samples to monitor concentrations of gamma-emitting radionuclides in soil at DEQ-INL OP air monitoring stations and selected soil sampling sites on and around the INL (2012 soil sampling sites are shown in **Figure 22**). A portable gamma radiation detector was used in the field to collect gamma radiation spectra (*in-situ* soil measurements). In addition to the *in-situ* measurements, physical soil samples were collected and prepared in the field at seven locations during the third calendar quarter of 2012. Both types of measurements were then used to identify radionuclides present and to estimate soil radioactivity concentrations.

DEQ-INL OP 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 example, milk samples from Mud Lake were collected from a truck servicing that area once it returned to the Nelson-Ricks Creamery distribution center in Rexburg, Idaho. For the independent cow and goat dairies, DEQ-INL OP 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-INL OP 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-INL OP for analysis. DEQ-INL OP used the analysis results from these split samples to verify the DOE contractor’s milk sampling results and conclusions.

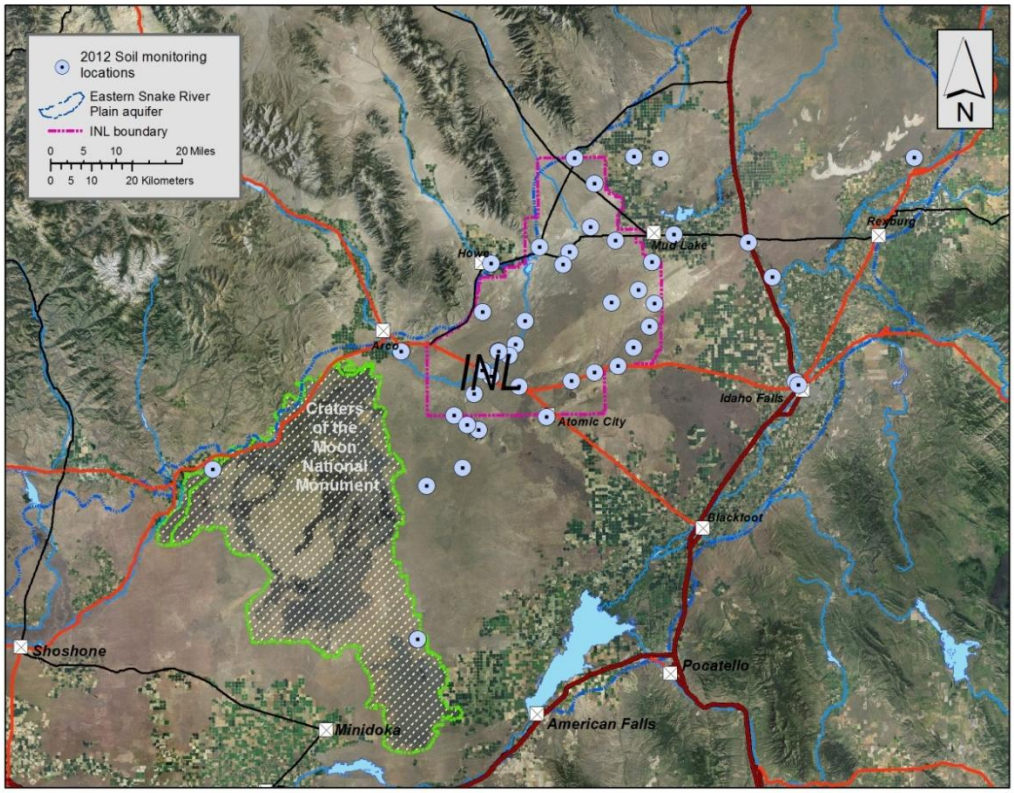


Figure 22. DEQ-INL OP soil sampling locations for 2012.

Terrestrial Monitoring Results and Trends

Gamma-emitting radionuclides in surface soil are monitored to provide insight to the transport, deposition, and accumulation of radioactive material released to the environment as a result of INL operations and historic atmospheric testing of nuclear weapons. During 2012, DEQ-INL OP made *in-situ* gamma spectrometry measurements to estimate accumulations of gamma-emitting radionuclides in surface soil at 44 locations. DEQ-INL OP also collected 14 physical samples of surface soil at seven locations. Of the 51 measurements, ^{137}Cs was the only man-made radionuclide that was detected. The average ^{137}Cs value, including physical samples analyzed by ISU-EML and *in-situ* measurements, was 0.24 picocuries per gram (pCi/g) with a minimum value of 0.03 pCi/g and a maximum of 1.96 pCi/g. These concentrations are well below the recommended screening level for surface soil of 6.8 pCi/g (National Council on Radiation Protection and Measurements, NCRP Report No. 129, 1999).

Milk sampling is conducted by DEQ-INL OP to determine whether radioactive iodine is present or absent in the food supply. Radioactive iodine 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 radioactive iodine 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 radioiodine in the milk they produce. Drinking this milk could lead to an accumulation of radioactive iodine in the thyroid gland and a greater risk of thyroid cancer.

During 2012, DEQ-INL OP analyzed 64 milk samples. Radioactive iodine was not detected in any milk sample. The DEQ-INL OP action level of 4.4 pCi/L is based upon the radioiodine

concentration in milk that would cause an infant to receive an annual thyroid radiation dose of 5 millirem.

Terrestrial Monitoring Verification Results

Naturally occurring ^{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-INL OP and DOE sample results include this isotope, especially since the target radionuclide (such as ^{131}I) 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-INL OP for analysis were compared with DOE results. ^{40}K results obtained by DEQ-INL OP showed 83% agreement with DOE contractor results, which is considered satisfactory. All ^{131}I results were below the minimum detectable activity for both agencies.

In-situ gamma spectrometry results from soil at seven co-located sample sites were compared with the DOE contractor's results. DEQ-INL OP and DOE contractor results for ^{137}Cs showed 57% agreement based on OP's criteria. The average results for ^{137}Cs are 0.63 pCi/g for DEQ-INL OP and 0.78 pCi/g for the DOE contractor. These results were well below the recommended screening level of 6.8 pCi/g for surface soil.

Gamma spectrometry results from physical soil samples taken at seven co-located sample sites were compared with the DOE contractor's results. There was 43% agreement between the agencies with the average results for ^{137}Cs of 0.28 pCi/g for DEQ-INL OP and 0.43 pCi/g for the DOE contractor. These results were well below the recommended screening level of 6.8 pCi/g for surface soil. Known differences in sampling protocol may have contributed to a wider range of activities noted by both organizations. These anomalies will be investigated further.

Terrestrial Monitoring Impacts and Conclusions

Based upon terrestrial radiological measurements of soil and milk, there were no discernible 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

This section summarizes the results of the quality assurance (QA) assessment of the data collected for calendar year 2012 for the DEQ-INL OP's Environmental Surveillance Program. All analyses and quality control (QC) measures at the analytical laboratories used by the DEQ-INL OP were performed in accordance with approved written procedures maintained by each analytical laboratory. Sample collection was performed in accordance with written procedures maintained by the DEQ-INL OP. Analytical results for blanks, duplicates, and spikes were used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During calendar year 2012, the DEQ-INL OP submitted 312 QC samples for various radiological and non-radiological analyses. All data collected were assigned the applicable qualifiers to designate the appropriate use of the data, validated, and deemed complete, meeting the requirements and data quality objectives established by DEQ-INL OP.

Issues and Problems

There was one significant QC issue identified during calendar year 2012 affecting air particulate results. During the third and fourth quarters of calendar year 2012, the TSP air sampler located at the Mud Lake air monitoring station experienced technical difficulties. Due to a malfunction of the internal heat sensor within the air sampler there was not a sufficient volume of air pulled through the filter to provide a valid sample. The heat sensor would automatically shut the sampler off. The lack of measurements during this time period had little effect on the overall agreement between DEQ-INL OP and ESER Stoller (84% gross alpha, 49% gross beta) reported in the air and precipitation section of this report. During the fall of 2012 an investigation of the sampler was performed; following a system reset the internal heat sensor no longer shut the sampler down. The sampler has been closely monitored, and the issue has not recurred at the Mud Lake monitoring station.

There was one significant QC issue identified during calendar year 2012 affecting direct radiation readings. During the third and fourth quarters of calendar year 2012, the EICs located at the Fort Hall monitoring station exhibited radiation readings significantly below the normal Fort Hall EIC quarterly average and the corresponding HPIC quarterly averages. The two quarters in question immediately followed significant damage to the station by a hit and run driver. After the accident the EICs were moved to an undamaged side of the fenced area. After the fence was fixed, the EICs were deployed at the original location in the first quarter of 2013. Preliminary results for the first quarter 2013 show that the EIC radiation readings and HPIC average meet DEQ-INL OP agreement criteria, but with the EIC readings still somewhat below the HPIC average.

Comparing Data

In addition to reporting independent monitoring results, DEQ-INL OP also determines whether the information collected by DOE matches the information and/or conclusions reached by DEQ-INL OP. One basic tool used by DEQ-INL OP to conduct these comparisons for all split sampling and some co-sampling, is to perform a measure of Relative Percent Difference (RPD) between DEQ-INL and DOE measurements. In general, for each sample collected by both DEQ-INL OP and DOE and/or its contractors, the DEQ-INL OP result is subtracted from the DOE result to determine the difference between the two measurements. This difference is divided by the mean of the results for that data pair. Dividing by this number serves to create a RPD, which can then be compared to other RPDs, regardless of the type of analyte or original measured result. This is best explained through the use of the following equation:

$$RPD = (((DOE\ result) - (DEQ\ result)) / ((DEQ\ result + DOE\ result)/2)) \times 100$$

The RPD calculated using the above equation is considered acceptable if it is within ±20%. DEQ-INL OP may also calculate an average of all the RPDs found for a specific test or analyte. DEQ-INL OP also uses standard radiological counting error (expressed as one standard deviation) to compare results for radiological analyses. Comparison tests that have an absolute difference in the two sample results of no more than three times the pooled error for these measurements are considered acceptable.

This comparison 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 = Counting error (one standard deviation) associated with the laboratory measurement of the first sample.
S_2 = Counting error (one standard deviation) associated with the laboratory measurement of the second sample.

Combined sample comparisons are considered satisfactory if at least 80% of the paired results agree to within the above criteria.

Assessing INL Impacts

DEQ-INL OP evaluates public health and environmental impacts from INL activities and proposed projects. DEQ-INL OP reviews INL's management of radiological materials and wastes, including inventories, storage, treatment, transportation, and disposal. DEQ-INL OP supports compliance determinations of the 1995 Settlement Agreement between Idaho, U.S. Navy, and DOE which outlines milestones for safe storage, treatment, and removal from Idaho of spent fuel, high-level waste, and transuranic waste. DEQ-INL OP also reviews INL safety concerns and incidents through the DOE Occurrence Reporting and Processing System (ORPS).

DEQ-INL OP observes and maintains awareness of activities not covered by DEQ's Waste Management/Remediation and Air Quality Divisions—who have regulatory authority over CERCLA site remediation, RCRA hazardous waste management, and INL air emissions. A summary of DEQ-INL OP's key priorities is presented in the following sections.

Transuranic Waste Shipments to the Waste Isolation Pilot Plant

Transuranic (TRU) waste generally consists of protective clothing, tools, glassware, equipment, soils, and sludge contaminated with radioactive elements with atomic number greater than uranium such as plutonium, neptunium, americium, curium, and/or californium. Transuranic waste is divided into two categories based on the surface radiation levels of unshielded containers packaged with the waste. TRU waste containers with surface radiation dose rates over 200 millirems per hour contain remote-handled transuranic (RH-TRU) waste. Containers with surface radiation dose rates below 200 millirems per hour contain contact-handled transuranic (CH-TRU) waste. Because of its high surface radiation dose rate, RH-TRU waste is transported in lead shielded casks.

Advanced Mixed Waste Treatment Plant Treatment of Contact-Handled Transuranic Waste

The Advanced Mixed Waste Treatment Plant (AMWTP) at the Radioactive Waste Management Complex (RWMC) packages waste stored at the Transuranic Storage Area (TSA) for shipment out-of-state. Transuranic (TRU) waste is shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico. TSA non-TRU waste that was previously handled as TRU is shipped to other out-of-state disposal facilities. According to the 1995 Settlement Agreement, INL must ship at least 2,000 cubic meters (initial volume – meaning prior to compaction) of TRU waste out-of-state each year over a three year running average. Additionally, the 1995 Settlement Agreement requires that all TRU waste be removed from Idaho by a target date of 2015 and no later than 2018.

After a slow start prior to 2006, AMWTP far surpassed the yearly goal of shipping 2,000 cubic meters of TRU waste to WIPP by shipping an average of more than 5,000 cubic meters each year from 2006 through 2010. During 2011, AMWTP's annual shipment rate decreased to about 2,000 cubic meters. However, in 2012 AMWTP's shipment rate increased to about 4,000 cubic meters of TRU waste sent to WIPP.

Some of the activities DEQ-INL OP performed in 2012 to ensure safe management of transuranic waste included:

- Tracked WIPP shipments and coordinated WIPP shipment safety with the Idaho State Police (ISP) (who inspect every outgoing truckload) and with other states through the Western Governors Association (WGA).
- Reviewed DOE reports detailing AMWTP progress on shipping TRU waste out of Idaho.
- Reviewed real-time radiography (RTR) screen shot paperwork for AMWTP box dumping operations to assure proper disposal volume credit was received for TRU waste processed though the AMWTP super compactor.
- Conducted visits to AMWTP to observe waste management activities.
- Observed the DOE Carlsbad Field Office yearly WIPP audit of AMWTP activities.

Remote-Handled Transuranic Waste Shipments

In early 2007, DOE made INL's and DOE's first shipment of RH-TRU waste to WIPP in New Mexico. Throughout 2012 DOE continued to ship RH-TRU waste to WIPP. DOE is currently characterizing, sorting, treating, and packaging for shipment RH-TRU waste stored in below ground vaults north of MFC at the Radioactive Scrap and Waste Facility (RSWF). This waste originated from MFC and Argonne National Laboratory-East. DOE has modified existing hot-cells at the Idaho Nuclear Technology and Engineering Center (INTEC) CPP-666 Building for RH-TRU waste processing activities. Transfer of the RSWF RH-TRU waste from MFC to INTEC began in 2009. Startup of RH-TRU repackaging in CPP-666 began in January 2010 and the first RSWF RH-TRU waste shipment was sent to WIPP in February 2010. Repackaging and shipment of this waste has continued through 2012 and is not projected to be completed for some time.

DEQ-INL OP personnel toured packaging facilities, attended meetings, and reviewed documents pertaining to the ongoing process of shipping RH-TRU waste to WIPP.

Accelerated Retrieval Project Activities

The Accelerated Retrieval Project (ARP) is a CERCLA activity to remove targeted waste buried prior to 1970 in the Subsurface Disposal Area (SDA) in the RWMC at the INL Site. Excavated targeted waste is identified, repackaged, characterized, and shipped off-site for disposal. Targeted waste characterized as transuranic is shipped to WIPP in New Mexico. Non-transuranic targeted waste is shipped to other off-site locations for treatment or disposal as appropriate.

Targeted wastes consist of:

- filters, graphite, and series 741 sludge containing transuranic radionuclides (i.e., ^{241}Am and $^{239/240}$Pu),
- series 743 sludge containing absorbed solvents, and
- depleted uranium contained in roaster oxides.

The ARP is being implemented in nine phases where targeted waste is excavated, packaged, and sent to WIPP for disposal. These nine phases are:

1) ARP I which was completed in 2008 with excavation of 0.50 acres.
2) ARP II which was completed in 2009 with excavation of 0.35 acres.
3) ARP III which completed excavation of 0.37 acres in 2009 but must wait for removal of some structures before the last 0.05 acre can be excavated.
4) ARP IV which was completed in 2011 with excavation of 0.79 acres.
5) ARP V which was completed in 2011 with excavation of 0.55 acres.
6) ARP VI which was completed in 2011 with excavation of 0.40 acres.
7) ARP VII which began excavation in 2012 but excavation was suspended due to budgetary issues.
8) ARP VIII which began construction in 2011 and had construction nearly completed at the end of 2012.
9) ARP IX which is slated to begin construction around 2018.

DEQ-INL OP personnel participated in numerous site visits to observe activities at ARP facilities and attended meetings where ARP progress was addressed.

Integrated Waste Treatment Unit Construction

In 2012, DOE completed construction of the Integrated Waste Treatment Unit (IWTU) – to treat approximately 900,000 gallons of sodium-bearing waste (SBW) currently in four 300,000 gallon tanks (one nearly empty) at the INTEC Tank Farm. Treatment will consist of solidification and preparation of this waste for off-site disposal. Solidification of SBW is required to meet the 1995 Settlement Agreement milestone that states, “DOE shall complete calcination of sodium-bearing liquid high-level waste by December 31, 2012.” SBW contains radioactive and hazardous constituents from previous spent nuclear fuel (SNF) reprocessing and decontamination activities. Calcination of sodium-bearing waste was suspended in 2000 and DOE selected steam-reforming in place of calcination to treat and stabilize the waste for final disposition. Steam-reforming technology will heat up the liquid waste, essentially drying it; consolidating the solid, granular material; packaging it in stainless steel canisters; and storing the containers in concrete vaults at the site while final disposal decisions are made.

On June 16, 2012, during start-up testing (prior to addition of any radioactive or hazardous materials) the IWTU experienced a pressure event that caused the IWTU safety systems to safely shut down operations. The IWTU uses wood-based charcoal to bring the facility up to a temperature of 700 degrees Celsius. A component of the facility, the Carbon Reduction Reformer (CRR), became overloaded with charcoal which only partially burned due to the excess amount of charcoal and lack of adequate oxygen. The CRR ground the excess charcoal into a fine dust which passed through the CRR clogging the down-stream high efficiency particulate filters (HEPA) and off-gas filters resulting in the pressure event. Before the IWTU can restart it must be modified to prevent a reoccurrence of the pressure event. Modifications to the facility will center around introducing more oxygen into the CRR for better charcoal combustion; securing filter bundles so they do not move due to pressure changes; ensuring the back-pressure systems operate as designed; installing additional pressure-relief valves; and adding additional layers of monitoring to detect pressure variations. While these modifications were evaluated, other potential problems were recognized and are also being addressed. It is anticipated that IWTU will not resume start-up testing activities until mid-2013.

DOE has missed the 1995 Idaho Settlement Agreement milestone requiring that SBW be solidified by December 31, 2012. Therefore, per the enforcement agreement in the 1995 Idaho Settlement Agreement, shipments of DOE spent fuel to INL have been suspended until treatment of the SBW is completed.

DEQ-INL OP personnel attended briefings on the start-up testing activities and on the pressure event, toured the IWTU facility, and attended meetings where IWTU progress/problems were discussed.

High Level Waste/Calcine Disposition Planning

The INL Calcine Disposition Project (CDP) is currently preparing construction and operation plans for a facility to treat calcine for disposal in a geologic repository. This calcine was produced from spent nuclear fuel reprocessing liquid waste that was solidified at the INL Site from 1953 to 2000.

Most of the acidic liquid waste produced during spent nuclear fuel reprocessing was calcined into a dry granular solid using a high temperature process that reduced the volume by about seven-fold. Calcining of the acidic liquid waste also greatly reduced the threat of it contaminating the Snake River Plain Aquifer. About 4,400 cubic meters of calcine is currently stored in 43 stainless steel bins within six massive shielded and reinforced concrete silos located at INTEC on the INL Site. The calcine is a mixed waste that is highly radioactive with a dose rate of up to 6,000 Roentgen per hour.

In December 2009, the Department of Energy (DOE) documented in a Record of Decision (ROD) its decision to use Hot Isostatic Pressing (HIP) technology for treatment of the calcined high level waste. In the HIP process, calcine and treatment additives will be mixed and then loaded into thin wall cans that will be welded shut. These cans will be placed in a pressure vessel, which will be heated to “melt” the calcine mixture while compressing the can with high pressure argon gas to reduce volume.

Per the 1995 Settlement Agreement, DOE is required to have the calcined waste prepared for transport to a facility outside of Idaho by a target date of December 31, 2035. Additionally, the Settlement Agreement required that a RCRA Part B Permit be submitted to the State by December 1st of 2012; this requirement was met. Once the RCRA Part B Permit is finalized with the State, further work on calcine disposition planning will be delayed until after 2016 due to Federal budget constraints.

DEQ-INL OP personnel maintained contact with DOE personnel involved with the CDP and attended meetings where CDP progress was detailed.

Spent Nuclear Fuel - Receipt and Movement from Wet to Dry Storage

During 2012, INL continued to receive spent nuclear fuel (SNF) shipments from DOE and the Navy under parameters specified in the 1995 Settlement Agreement. Most of the SNF at INL has been placed in dry storage. According to the 1995 Settlement Agreement, DOE has agreed to complete the transfer of all INL SNF from wet storage to dry storage by the end of 2023 and remove all SNF from Idaho by 2035.

DOE completed transfer of DOE Environmental Management (EM)-owned SNF from wet storage in Building CPP-666 to dry storage in Building CPP-603 in 2010. This leaves only the DOE Nuclear Energy (NE) and Navy SNF in CPP-666 wet storage at INTEC. DOE NE SNF includes: 1) Experimental Breeder Reactor II (EBR II) SNF which is being moved to the Materials and Fuels Complex (MFC) for treatment and 2) Advanced Test Reactor SNF that is being removed when it has cooled enough to be moved to dry storage.

During 2012:

- The DOE INL Site received two truck cask shipments containing Foreign Research Reactor (FRR) SNF.
- The Navy received three rail shipments containing five containers of SNF at the Naval Reactors Facility (NRF).
- The Navy moved some of its SNF from CPP-666 to NRF where it is placed in dry storage. Movement of Navy SNF from CPP-666 to NRF will continue for several more years.
- The Idaho Settlement Agreement milestone requiring solidification of sodium bearing waste (SBW) by the end of 2012 was not met, resulting in suspension of shipments of additional DOE spent fuel to the INL until treatment of the SBW is completed. However, receipt of Navy spent fuel continues as the Navy and DOE are treated as separate entities in the enforcement agreement section of the 1995 Idaho Settlement Agreement.
- Some of the activities DEQ-INL OP performed that were related to the safe management of SNF included:
    - Tracked shipments of SNF into Idaho from foreign and domestic research reactor SNF change-outs and naval nuclear reactors.
    - Maintained awareness of SNF sources, characteristics, and storage locations as the inventory of SNF changed at the INL.

- Monitored mission need activities associated with decisions regarding the Idaho Spent Fuel Facility (formerly the proposed Foster Wheeler fuel storage facility project) which will be used to repackage SNF for shipment out of state.
- Reviewed NRF SNF shipment quarterly reports.

Occurrence Reporting and Processing System Reviews

The DOE Occurrence Reporting and Processing System (ORPS) is an integral part of the DOE Occurrence Reporting Program. This program provides timely notification to DOE of events that could adversely affect: public or DOE worker health and safety, the environment, national security, DOE's safeguards and security interests, or functioning of DOE facilities. DOE ORPS reports provide an important resource for obtaining information on: numbers and types of these events, common or related causes for these events, effectiveness of corrective actions, and lessons learned.

Some of the activities DEQ-INL OP performed to monitor the ORPS were:

- Reviewed ORPS reports for events that occurred on the INL site.
- Performed follow-up on selected ORPS reports to assess how DOE addressed some safety and environmental incidents which occurred at the site.

National Environmental Policy Act Monitoring and Reviews

The National Environmental Policy Act (NEPA) establishes a national framework for protecting the environment. NEPA requires that Federal agencies consider the environmental impacts of their proposed actions and reasonable alternatives to those actions. The NEPA process is intended to help public officials make decisions that are based on understanding environmental consequences and take actions that protect, restore, and enhance the environment. The three basic levels of NEPA review and documentation are: (1) Environmental Impact Statement (EIS); (2) Environmental Assessment (EA); and (3) Categorical Exclusion (CX). The type of proposed action and the degree of environmental impacts determine the appropriate level of environmental review.

During 2012, the DEQ-INL OP monitored the status of the following EAs and EISs pertinent to INL:

1) Idaho High-Level Waste and Facilities Disposition (DOE/EIS-0287)
2) Disposal of Greater-Than-Class-C Low-Level Radioactive Waste (DOE/EIS-0375)
3) Proposed Consolidation of Nuclear Operations Related to the Production of Radioisotope Power Systems (DOE/EIS-0373)
4) Hanford Tank Closure and Waste Management, Richland, Washington (DOE/EIS-0391)
5) Storage and Management of Elemental Mercury (DOE/EIS-0423)
6) Wind Turbine Power Generation Complex at Idaho National Laboratory (DOE/EA-1857)
7) EIS Notice of Intent (NOI) for Navy Recapitalization of Infrastructure

Radiological Emergency Response Planning and Preparedness

DEQ-INL OP's role in emergency response planning and preparedness is defined in detail in the Environmental Oversight and Monitoring Agreement (EOMA) with the DOE. DEQ-INL OP works with DOE and INL contractors to evaluate and participate in response planning, and to respond to incidents. DEQ-INL OP works with state and 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-INL OP's emergency response activities are directed towards planning and response to INL incidents. The DEQ-INL OP also responds to non-INL radiological incidents as needed 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-INL OP provides technical information, assistance, and training to local and state authorities for incidents involving radiological 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-INL OP to identify scenarios that could potentially result in off-site radiological impacts, and plan appropriate responses. DEQ-INL OP uses the source inventory and accident scenarios from the HADs to develop input for atmospheric dispersion and dose modeling using the Air Pollutant Graphical Environmental Monitoring System (APGEMS). APGEMS uses real time NOAA weather data. This allows DEQ-INL OP to make independent radiological plume and dose projections to support timely technical and protective action recommendations to state emergency authorities.

INL Radiological Incidents

Radioactive particles were discovered outside facilities at the ATR Complex on April 2, 2012. At about the same time, the INL released several leased buses to be returned to their owner. Because of concern for possible release of contaminated equipment, the Department of Energy's Radiological Assistance Program team (DOE RAP) was called out to survey the buses at an off-site parking area. DEQ-INL OP staff observed the DOE RAP's survey work to confirm the adequacy of the measurements. Results of the survey indicated that no radiological contamination was present on any of the buses.

Non-INL Radiological Incidents

DEQ-INL OP staff has assisted in the characterization and safe disposal of several radioactive items throughout the state, (mostly objects found in loads of scrap metal). The activity levels have been extremely low and of no potential risk to the public.

DEQ-INL OP responded to a RAP team callout in Pocatello to investigate a semi-trailer used to haul scrap metal for recycling in Utah. The loaded trailer had been rejected on several occasions because the recycling facility's portal monitor indicated the presence of elevated radioactivity.

DEQ-INL OP observed an exhaustive survey of the trailer by RAP DOE. Ultimately, it was concluded that residual material from welding rods containing thorium that were used to construct the trailer caused the portal monitor to generate spurious responses. The trailer posed no hazard to the public, although it did cause the recycler significant operational difficulties.

A DEQ-INL OP staff member was tasked with determining the radiological risk to firefighters and the public in general resulting from exposure to smoke and dust emissions from the large Mustang Complex Fire north of Salmon in 2012. This project was undertaken at the request of the U.S. Forest Service specifically because of concern over possible releases of radioactive material caused by fires passing over former mining and milling operations. Materials of concern include uranium, thorium, and their associated decay products (including radon), all of which are radioactive, naturally occurring, and widely distributed in the environment. The DEQ-INL OP measured airborne radioactivity in North Fork, Idaho, on September 21–22, 2012, during the Mustang Complex wildfire to evaluate risks to residents and firefighters during off-work hours. Measurements indicated that a person spending one month in North Fork during the fires would receive a dose of approximately 0.03 millirem (mrem) from uranium and thorium in inhaled dust. Long-lived radon decay products released because of the fire could have caused a 0.5 mrem dose over the same period. Both of the measured doses were small (<1%) compared to the typical 310 mrem annual dose that US citizens receive from natural sources, which includes 230 mrem from exposure to short-lived radon decay products, primarily while indoors.

DEQ-INL OP also reviewed information from Nuclear Regulatory Commission (NRC) and Environmental Protection Agency studies to evaluate potential exposure of firefighters. The NRC made estimates of doses caused by abandoned uranium mines, including inhalation of ore dust. The NRC estimated that forest service rangers who spend 100 hours per year walking over an abandoned uranium mining site covering “a number of acres” would receive a 5 mrem dose each year. Similar doses would result for locations with thorium-bearing soil. Firefighters would most likely move over larger areas during 100 working hours, so the NRC’s model likely overestimates their potential doses. The potential radiation doses received by wildland firefighters in Idaho are much less than the natural annual background radiation exposure in the U.S., and well within the natural variation of exposure between locations in the U.S.

Drills and Exercises

DEQ-INL OP staff participated in the NRF tabletop drill in November 2012. This drill included participation by Bingham Memorial Hospital and the Eastern Idaho Regional Medical Center. DEQ-INL OP staff also attended the CWI annual exercise during July 2012. The CWI exercise included simulated receipt of contaminated patients at Bingham Memorial Hospital. A DEQ-INL OP staff member acted as a controller at the joint Region II Response Team/101st Army Weapons of Mass Destruction (WMD) team re-qualification exercise in Lewiston during June 2012.

Waste Isolation Pilot Plant Shipment Safety

DOE contracts with the Western Governors Association (WGA) to coordinate activities supporting the safe shipment of transuranic waste to WIPP through western states. DEQ-INL OP works with the Idaho State Police (ISP) and the IBHS to manage WIPP shipment safety activities on the US Route 20/26, Interstate 15, and Interstate 84 / 86 corridors in Idaho.

During 2012, DEQ-INL OP:

- Provided emergency responder training.
- Oversaw radiological equipment procurement and calibrations for ISP, all seven Idaho regional response teams, the Shoshone-Bannock Tribes, and three area hospitals.
- Provided public information support. Staff members also attended the WIPP Media Day presentation at Fort Hall on May 25th.

Support and Training of Idaho Radiological Emergency Responders

DEQ-INL OP staff attended numerous Regional Response Team (RRT) meetings, several Local Emergency Planning Committee (LEPC) meetings and the INL Emergency Working Group meetings. Several Emergency Response classes were also taken at the Idaho Hazardous Materials (Haz Mat) Week in Boise in 2012.

Classes and Presentations

Among other duties performed by DEQ-INL OP staff, 74 first responders along with hospital staff were trained on actions and procedures to be followed at an incident involving radiological material. A presentation was given by staff to the South East Idaho Health District's Solid Waste Committee describing characteristics of radiological material that could be incorrectly sent to their disposal and transfer sites.

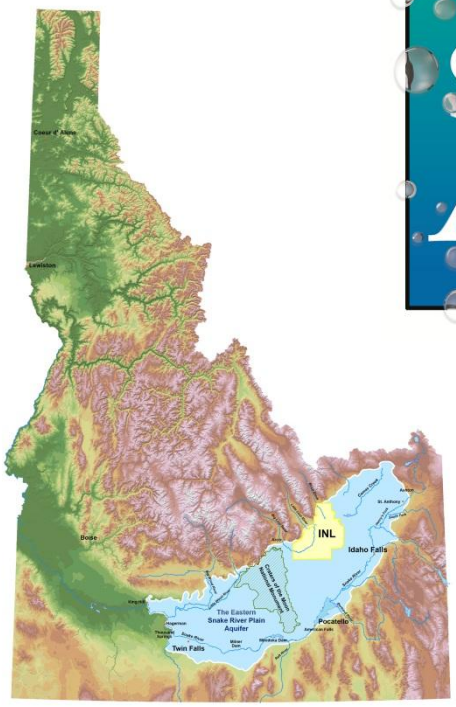
Public Outreach

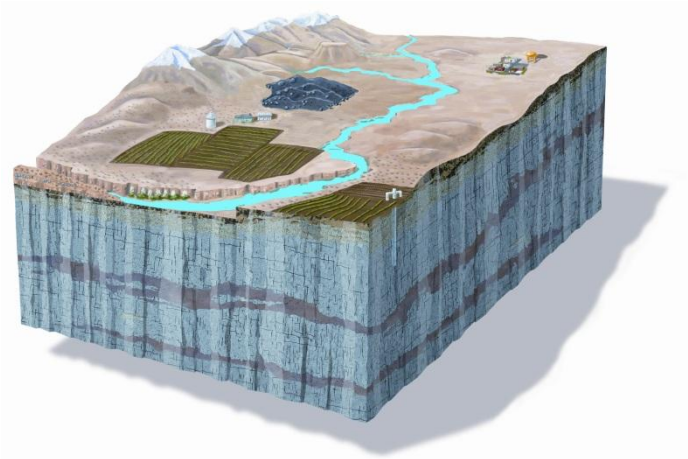
A fundamental aspect of DEQ-INL OP's work is sharing our findings with the public and factoring public input into our activities and policy recommendations. DEQ-INL OP uses several tools to provide Idahoans with independent, accurate, and timely information about activities relating to the INL and other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

Publications

DEQ-INL OP regularly issues technical and non-technical publications to communicate the findings and activities of our program. In 2012, we issued:

- The DEQ-INL Oversight Program Annual Report for 2011.
- Four quarterly environmental surveillance data reports.
- The DEQ-INL Oversight Program Publication: **Idaho's Treasure; The Eastern Snake River Plain Aquifer** – Fall 2012. Some of the following topics covered:
  - Anatomy of a priceless resource
  - What is an Aquifer?
  - Craters of the Moon geology offers insight into aquifer





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

Presentations and Events

DEQ-INL OP also communicates with the public about INL-related issues through schools, fairs, special interest groups, and public events. In 2012, we gave public presentations on the aquifer, and INL Site issues to a range of schools, civic groups, and special interest groups.

At the Twin Falls County Fair, we presented information on water nitrate testing, crop burning, and our various publications for the public to review and ask questions. We presented Edible Aquifer hands-on activities for the youth to participate and learn about the importance of our aquifer (**Figure 23**).

The Water Festival event was attended by over 1,000 students and we presented the rain stick activity in **Figure 24**. Idaho Falls Earth Day was a hit with the youth enjoying the Edible Aquifer presentations and the adults filling up the DEQ-INL OP carry-all bags with Earth Day giveaways shown in **Figure 25**. Challis Elementary was given the opportunity to have a mini Water Festival that included a hands-on Edible Aquifer activity shown in **Figure 26**.

Figure 23. Children enjoying the Edible Aquifer activity at the Twin Falls Fair.

Figure 24. DEQ staff demonstrating how to make rain sticks and emphasizing importance of clean water for Water Festival 2012.

Figure 25. DEQ-INL Oversight Program participating in the 2012 Earth Day event

Figure 26. Students participating in the Edible Aquifer activity at Challis Elementary.

Community Monitoring Network

DEQ-INL OP 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/. **Figure 27** shows one community monitoring station.

Figure 27. Community monitoring station at the greenbelt in Idaho Falls.