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# *CERCLA Remedial Actions at Idaho Site (Groundwater Focus)*

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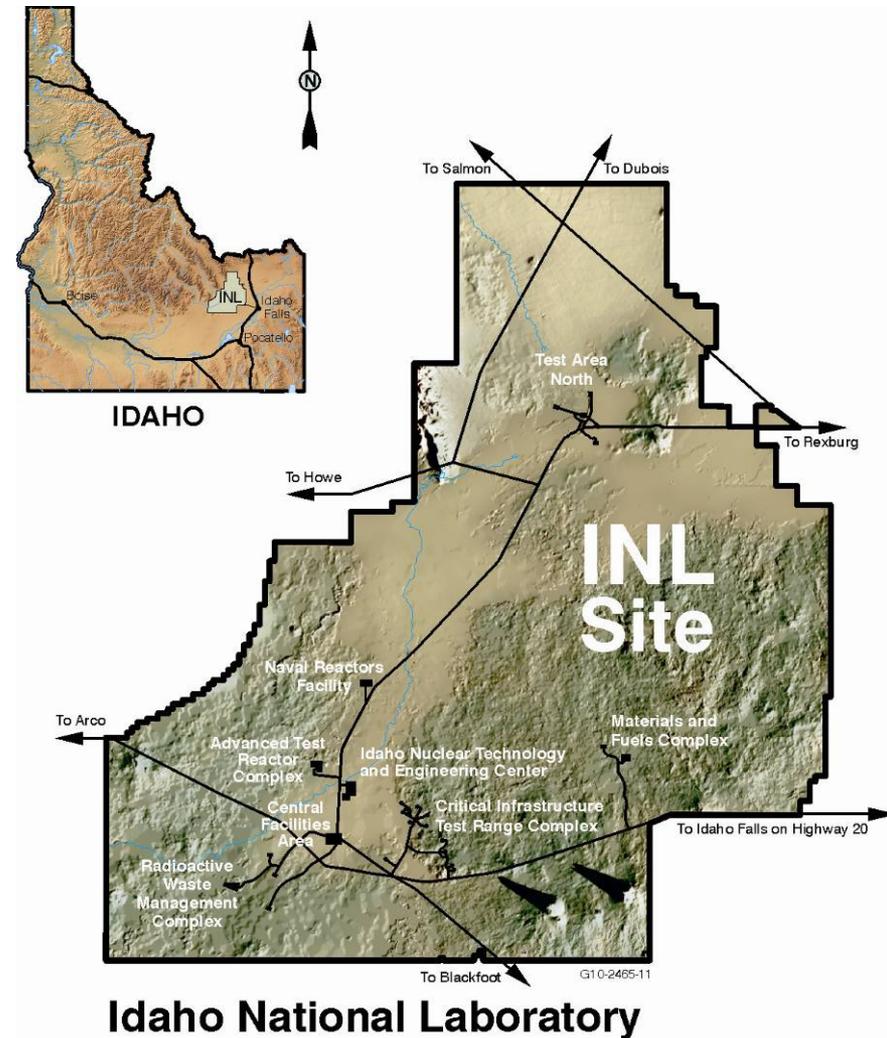
**February 12, 2014**



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# CERCLA Review

- The INL Site was placed on the National Priorities List in 1989 because of groundwater contamination in the Snake River Plain Aquifer (SRPA).
- In December 1991, DOE, EPA, and the State of Idaho signed the Federal Facility Agreement and Consent Order (FFA/CO) and Action Plan, which is referenced in the 1995 Settlement Agreement.
- Idaho Cleanup Project remediates past releases to the environment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).



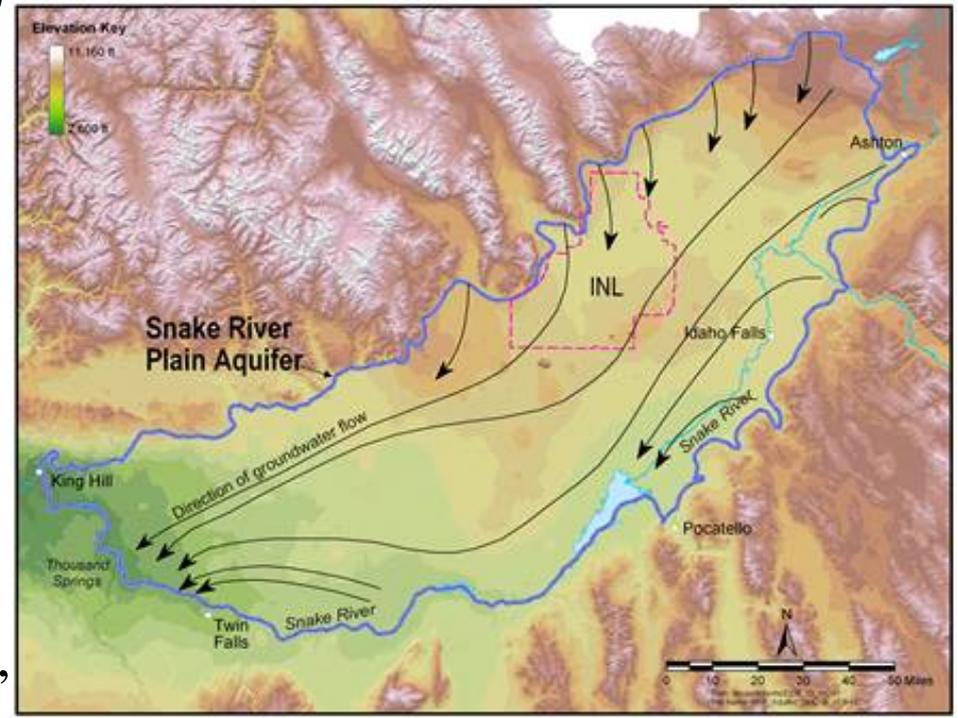
# INL Site CERCLA Background

- INL Site is divided into 10 Waste Area Groups (WAGs).
- WAGs 1 to 9 correspond to facilities; WAG 10 is Site-wide.
- Each WAG has a Comprehensive Record of Decision (ROD) that addresses groundwater, human and ecological risk, and soil sites.
- Each WAG with groundwater contamination has actions in place to achieve MCLs by 2095.



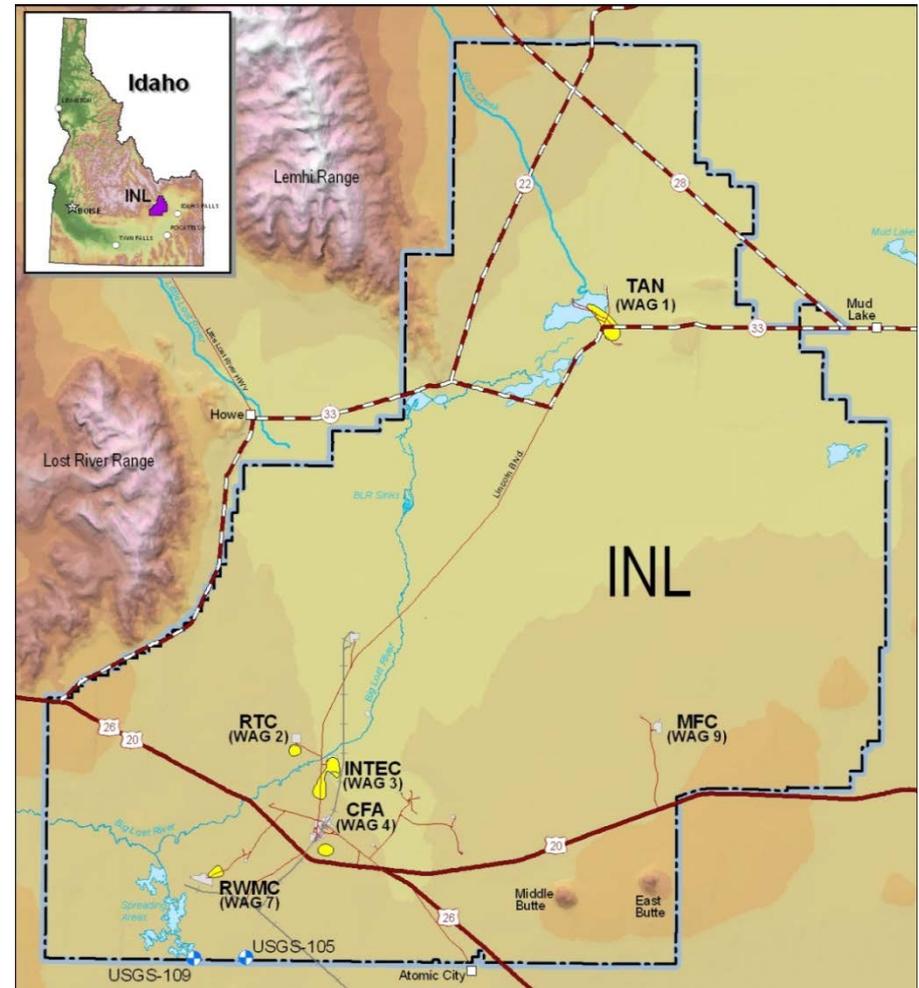
# Snake River Plain Aquifer

- Snake River Plain Aquifer (SRPA) underlies most of the INL Site.
- Groundwater flows south/southwest at approximately 5 to 10 ft/day.
- Depth to aquifer is 225 ft at the northern boundary of the INL Site and >625 ft at the southern boundary.
- Aquifer begins near Ashton, Idaho, and discharges to the Snake River between King Hill and the Thousand Springs area.



# INL Groundwater Plumes

- WAG 1 – Test Area north (TAN)
- WAG 2 – Advanced Test Reactor Complex (ATR Complex)
- WAG 3 – Idaho Nuclear Technology and Engineering Center (INTEC)
- WAG 4 – Central Facilities Area (CFA)
- WAG 7 – Radioactive Waste Management Complex (RWMC)
- WAG 10 – Site-wide – 12 monitoring wells located near MFC down to the INL southern border
- There are no significant groundwater issues at WAGs 5, 6, 8, and 9.



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# WAG 1 – TAN

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## Missions:

- Developed and tested designs for nuclear-powered aircraft engines.
- Supported reactor and nuclear fuels safety tests.
- Investigated core materials from the Three-Mile Island reactor accident.

## Contaminants of Concern:

- Groundwater
  - Organic compounds: trichloroethylene (TCE), tetrachloroethene (PCE), 1-2 dichloroethene (DCE), vinyl-chloride (VC)
  - Radionuclides: strontium-90 (Sr-90) and cesium-137 (Cs-137).



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# ***Operable Unit 1-07B Background***

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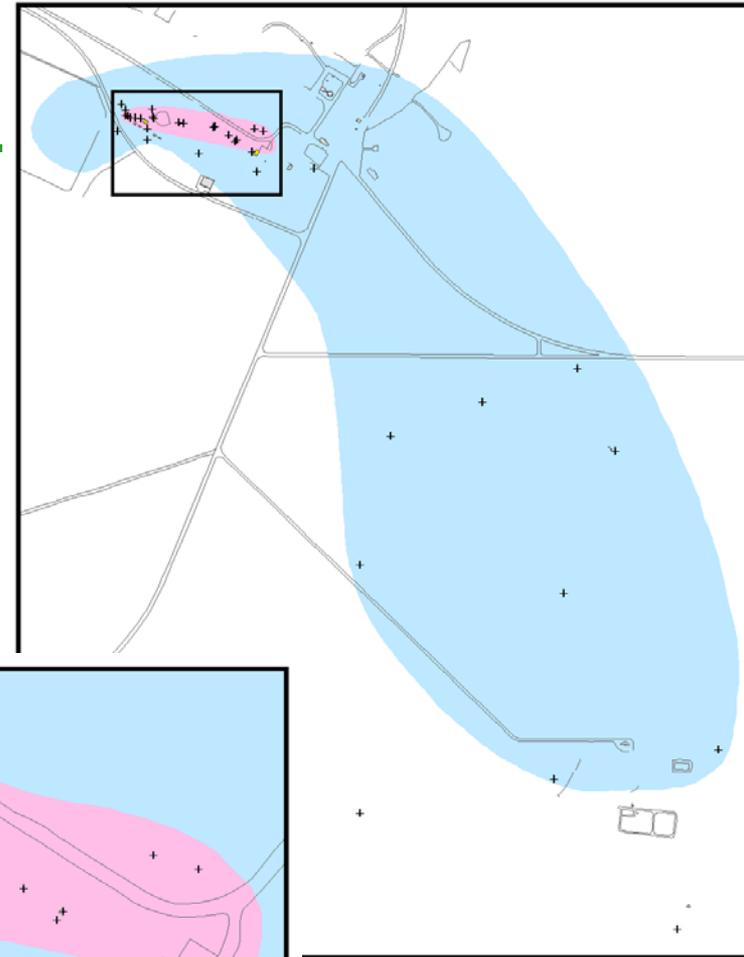
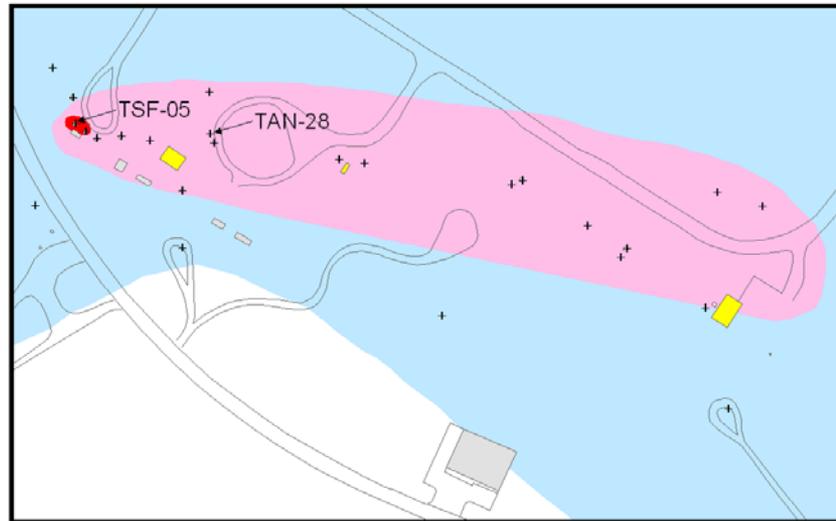
- An injection well at TAN, used from 1953 to 1972, contaminated the aquifer with solvents (Trichloroethylene - TCE), radioactive wastes, and sanitary sewage.
- Aquifer contamination was discovered in 1987.
- TCE plume is nearly 2 miles long.
- Selected remedy includes in situ bioremediation (ISB), pump and treat, and monitored natural attenuation (MNA).



# Three Plume Zones

Zones based on 1997 concentrations:

- Hot spot (>20,000  $\mu\text{g/L}$  TCE)
- Medial zone  
(1,000 to 20,000  $\mu\text{g/L}$  TCE)
- Distal zone  
(5 to 1,000  $\mu\text{g/L}$  TCE).



1997

## Legend

- > 20,000  $\mu\text{g/L}$  TCE
- 1,000 - 20,000  $\mu\text{g/L}$  TCE
- 5 - 1,000  $\mu\text{g/L}$  TCE
- + Well



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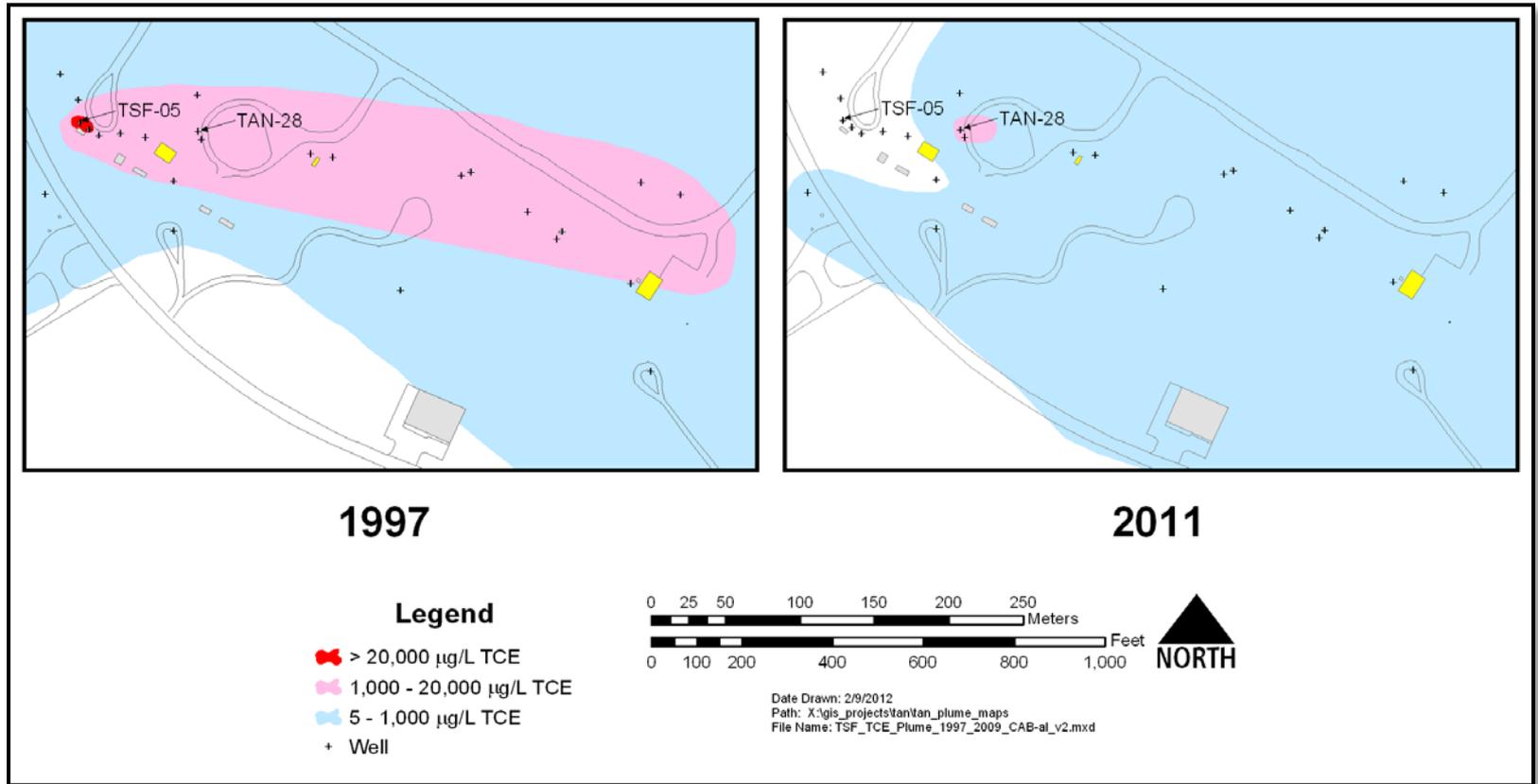
# *Three Remedy Components*

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- **In situ bioremediation (ISB)** – Injects food source (whey/lactate) into *hot spot* to feed naturally occurring microbes that degrade volatile organic compounds (VOCs).
- **Pump and treat** – Treats VOC concentrations in *medial zone* using New Pump and Treat Facility (NPTF).
- **Monitored natural attenuation (MNA)** – Monitors *distal zone* TCE concentrations while they decline
  - Expected to meet cleanup level by 2095
  - Plume allowed to expand by 30%.

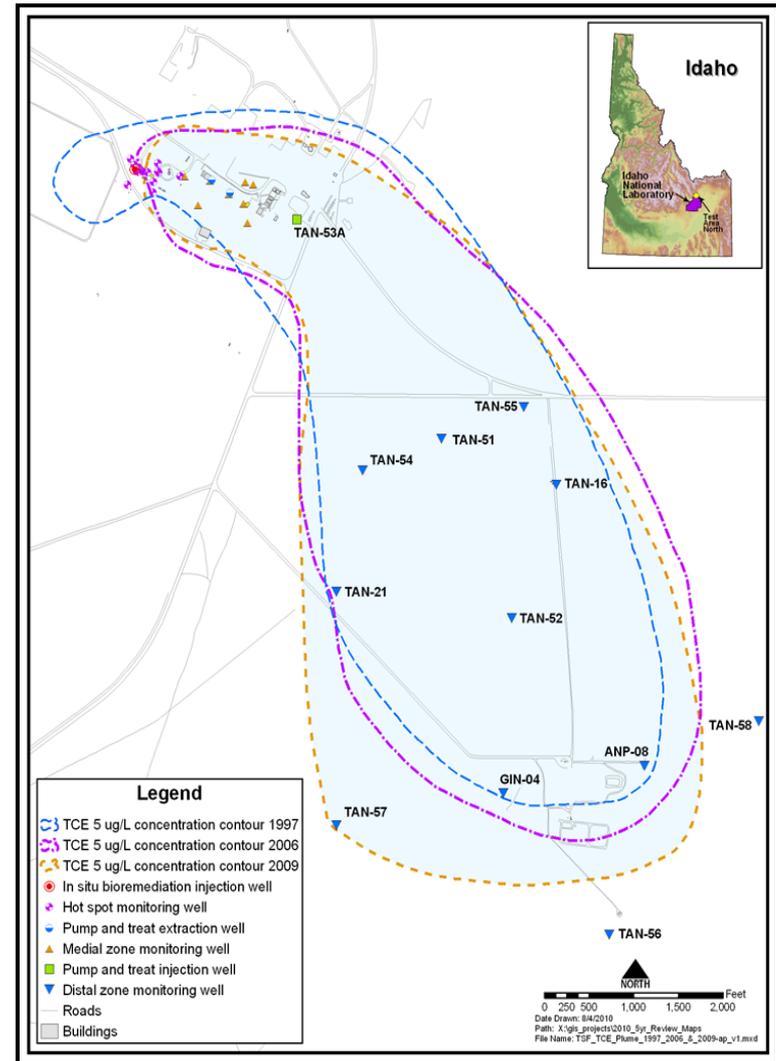


# Progress 1997 to 2011



# WAG 1 Summary

- ISB of the hot spot is currently in a rebound test.
- Pump and treat of the medial zone continues to operate. The medial zone TCE plume has contracted to a small area near Well TAN-28.
- More time is needed to determine whether MNA will meet maximum contaminant levels (MCLs) by 2095 for all areas of the plume (5 ug/L).
- Plume expansion is within allowed limits.



# ***WAG 2 – ATR Complex***

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## Missions:

- Studies the effects of radiation on materials, fuels, and equipment.
- Operates the Advanced Test Reactor and operated the Engineering Test Reactor and Materials Test Reactor.
- Produces isotopes for medicine and industry.
- Stores spent fuel.

## Contaminants of Concern:

- Groundwater
  - Radionuclides: tritium (H-3), strontium (Sr-90)
  - Metals: chromium (Cr).



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# ***WAG 2 Background***

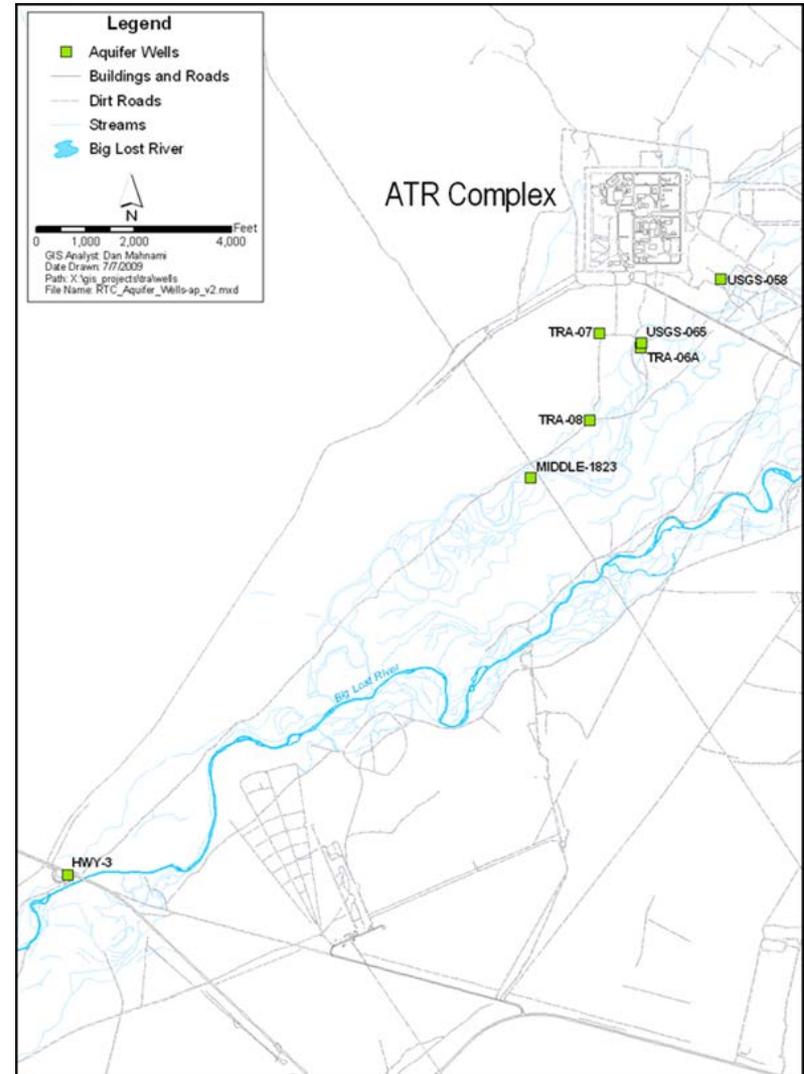
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- Chromium, used as a rust inhibitor for cooling systems, was injected into the aquifer from the Test Reactor Area (now ATR Complex) disposal well from 1964 until 1972. All discharges discontinued after 1982.
- Discharges to the warm waste pond from 1952 until 1993 resulted in soil and perched water contamination.
- Infiltration from the cold waste ponds may be aiding downward migration of contaminants in the soil.
- The OU 2-12 ROD selected monitoring of perched water.
- The OU 2-13 ROD selected monitoring of the aquifer to verify contaminant trends predicted by the computer model.



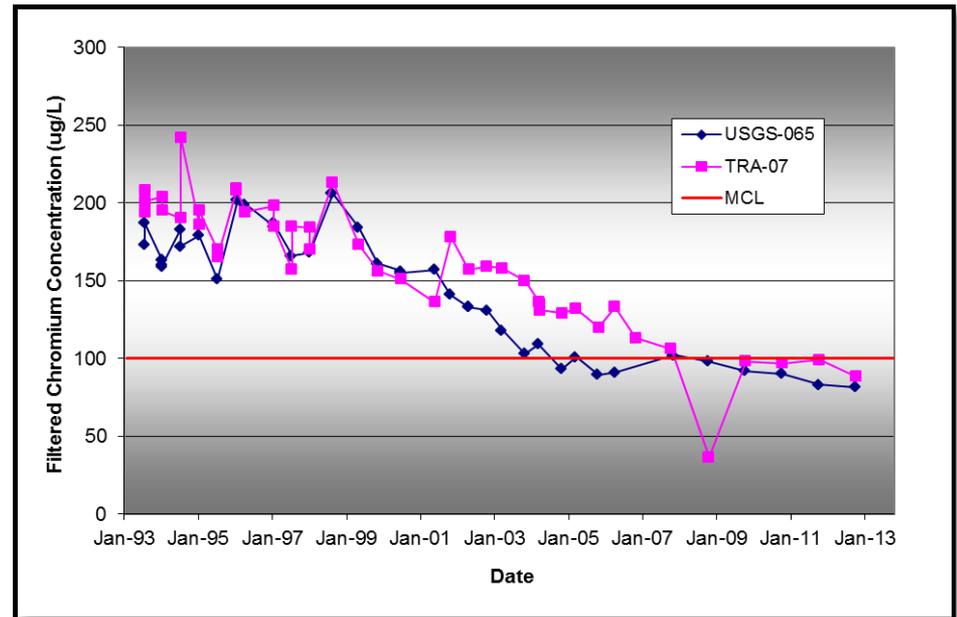
# Groundwater Monitoring Objectives

- Verify contaminants in the aquifer and perched water will decline as predicted in the computer modeling.



# WAG 2 Monitoring Summary

- Chromium concentrations are declining and were below the MCL in all aquifer wells for the first time in October 2008. Chromium declined below the MCL faster than predicted by computer modeling.
- Tritium concentrations declined below the MCL in the aquifer faster than predicted by computer modeling. Tritium was also below the MCL in perched water wells in FY 2013.



# WAG 3 – INTEC

## Missions:

- Reprocessed spent nuclear fuel.
- Stores spent nuclear fuel in both wet and dry storage.
- Stores and treats radioactive and mixed hazardous liquid waste.

## Contaminants of Concern:

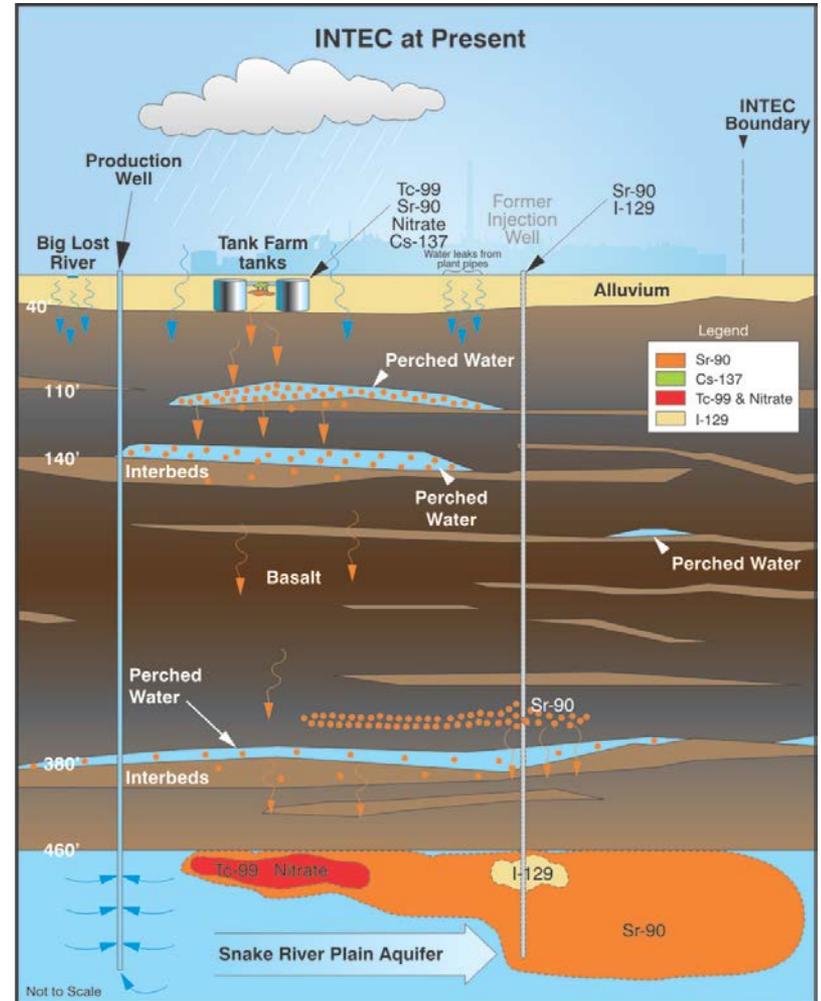
- Soils
  - Radionuclides: cesium-137 (Cs-137), strontium-90 (Sr-90), iodine-129 (I-129), americium-241 (Am-241), plutonium-238 (Pu-238)
  - Metals: chromium (Cr), mercury (Hg)
  - Organic compounds
  - Other (fluoride, nitrate, oil/grease).
- Groundwater
  - Radionuclides: strontium-90 (Sr-90), iodine-129 (I-129), technetium-99 (Tc-99)
  - Nitrate



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# WAG 3 Background

- Tank farm releases - contaminated soil (Cs-137), perched water (Sr-90), and the SRPA (Sr-90, Tc-99, nitrate).
- Former injection well - (used 1953 – 1984) contaminated aquifer (Sr-90, H-3, I-129).
- SRPA groundwater currently exceeds MCLs for Sr-90, Tc-99, and nitrate.
- Recharge increases downward migration of soil contaminants to perched water and SRPA.
- Selected CERCLA remedy includes
  - Institutional controls
  - Capping of tank farm area
  - Infiltration controls
  - Monitoring (aquifer and perched water).



## *OU 3-14 Remedial Action Goals*

- Reduce migration of contaminants (Sr-90) from the perched water to the aquifer by reducing recharge.
- Reduce water infiltration over ~10 acres surrounding the tank farm by installing low-permeability pavement.
- Reduce infiltration from anthropogenic (human-caused) water sources, such as leaking underground valves and water lines.

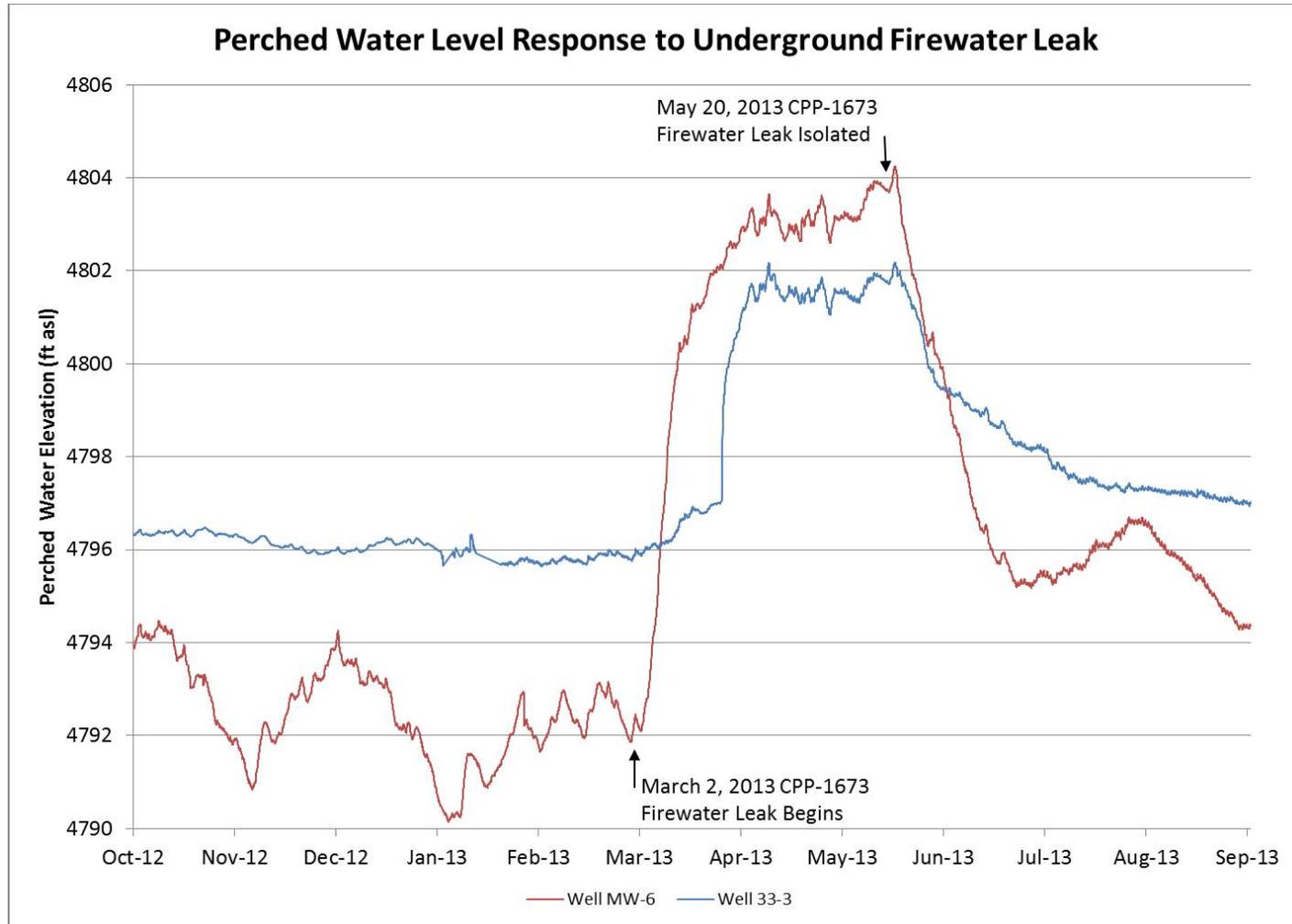


# *Anthropogenic Recharge Actions*

- Perform pipeline tests to identify leaks in suspect areas.
- Repair leaks – more than 20 major leaks have been repaired to date.
- Calculate water balances (inflow vs. outflow) to identify changes in system flows that could indicate leaks.
- Install additional flow meters to improve accuracy of water balance calculations.
- Install wellhead instruments for perched-water-level monitoring to detect subsurface leaks.



# Anthropogenic Recharge Example



# *WAG 3 Summary*

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- Sr-90, Tc-99, and nitrate remain above MCLs in the SRPA.
- Sr-90 concentrations in groundwater are declining.
- Tc-99 and nitrate concentrations remain relatively constant at most locations.
- Perched water volume has decreased over the past several years, but varies seasonally in response to precipitation.
- Underground pipeline leaks are isolated and repaired as they are discovered (~91 million gal of recharge eliminated 2000-2013).



# ***WAG 4 – CFA***

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## **Missions:**

- Originally housed U.S. Navy gunnery range personnel.
- Currently treats and disposes of non-hazardous industrial waste.
- Provides centralized support for the INL.

## **Contaminants of Concern:**

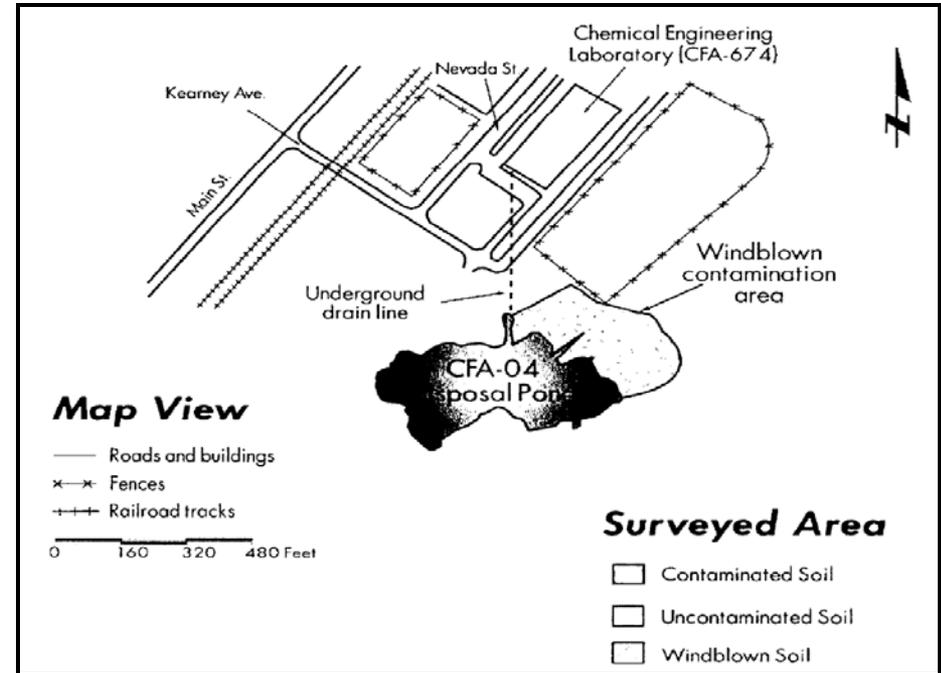
- Groundwater
  - Nitrate.



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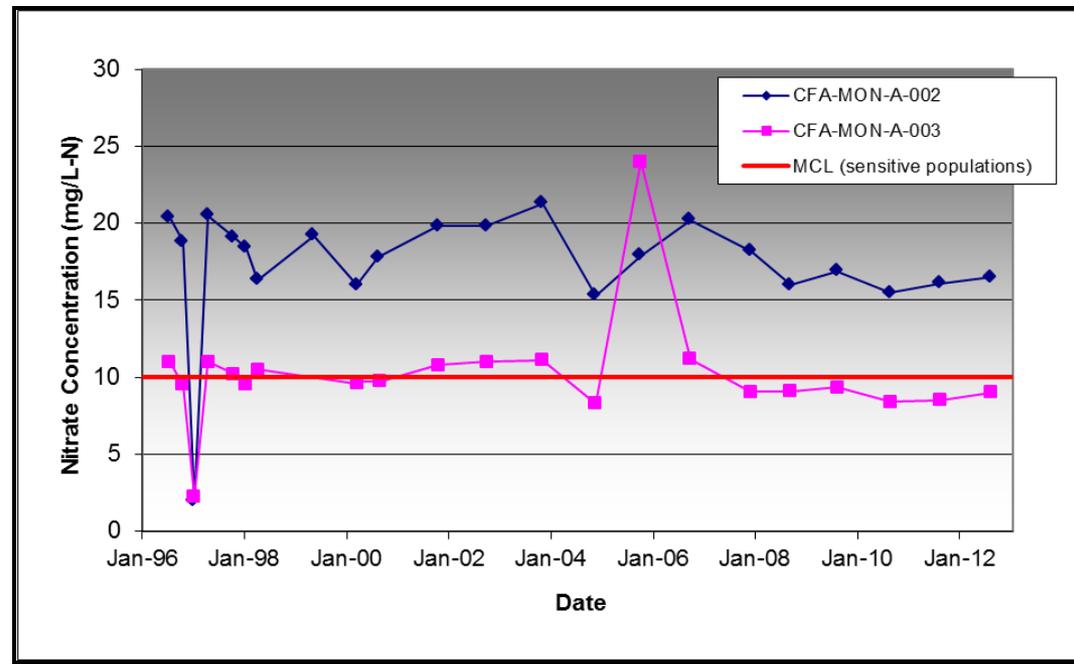
# WAG 4 – Background

- Nitrate in the aquifer originated from the CFA-04 dry pond, which received waste from the CFA Chemical Engineering laboratory from 1953 to 1965.
- OU 4-13 Comprehensive ROD requires monitoring of the nitrate plume south of CFA.



# Groundwater Monitoring Objectives

- CFA nitrate plume
  - Monitor the groundwater south of CFA until nitrate levels fall below the 10-mg/L MCL
  - Two wells remain above 10 mg/L-N
    - CFA-MON-002
    - CFA-MON-003
  - CFA nitrate plume concentrations are stable.



# WAG 7 – RWMC

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## Missions:

- Established for disposal of radioactive and hazardous waste.
- Ongoing remediation includes retrieving, characterizing, and packaging targeted buried waste for disposal off the INL Site.

## Contaminants of Concern:

- Groundwater
  - Volatile organic compounds (VOCs): carbon tetrachloride ( $\text{CCl}_4$ ) is the only COC above the MCL.
  - tetrachloroethene (PCE), trichloroethylene (TCE), and methylene chloride ( $\text{CH}_2\text{Cl}_2$ )
  - Mobile fission and activation products: carbon-14 (C-14), iodine-129 (I-129) and technetium-99 (Tc-99)
  - Nitrate

1,4-Dioxane.

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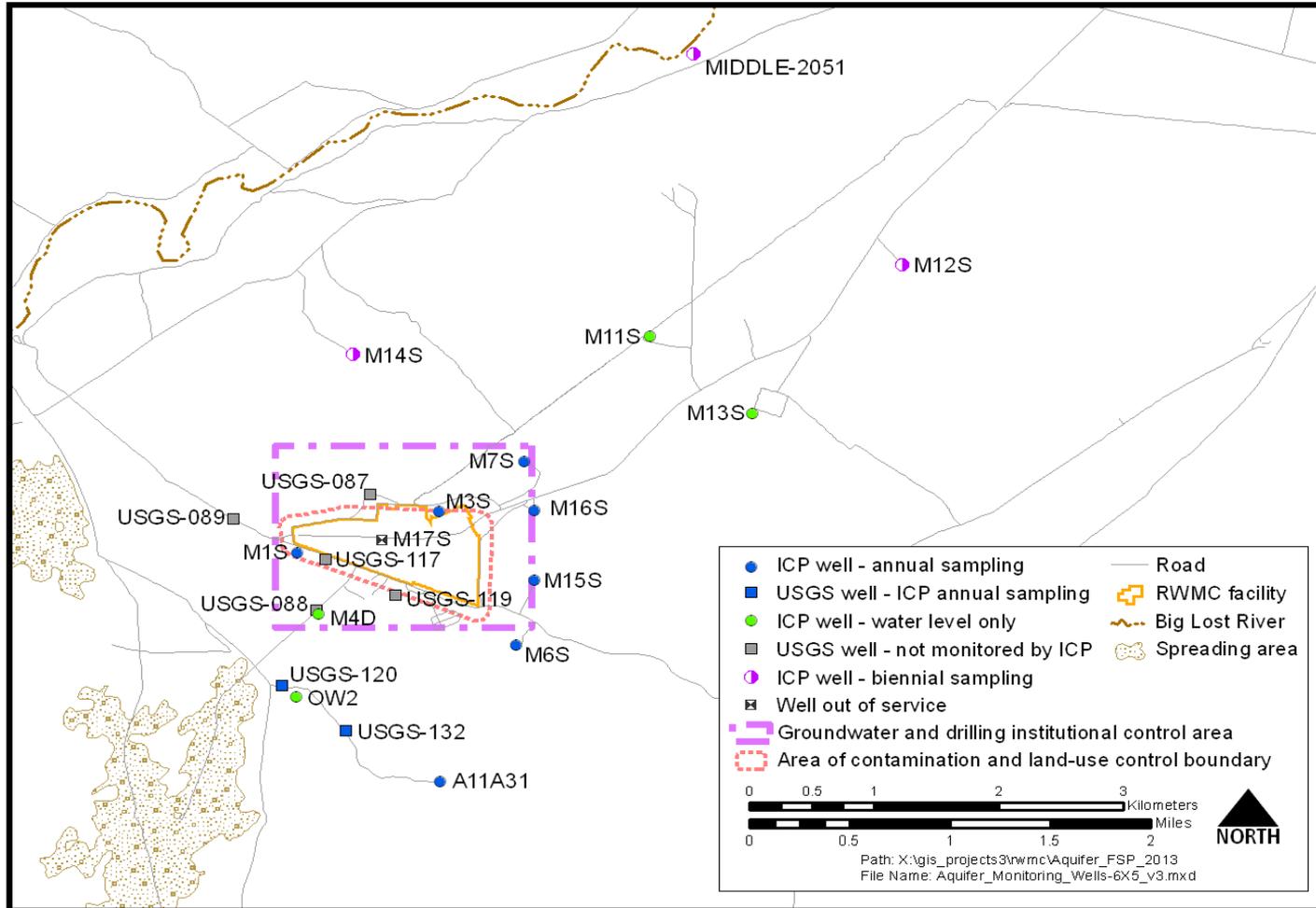
# ***WAG 7 – Background***

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- Waste buried in the Subsurface Disposal Area is the source of contamination affecting the SRPA
  - VOCs and 1,4-dioxane in organic sludges from Rocky Flats
  - Nitrate in evaporator salts from Rocky Flats
  - Fission and activation products (C-14, I-129, and Tc-99) from historical INL operations.
- The OU 7-13/14 ROD-selected remedy includes vapor vacuum extraction of VOCs, targeted waste retrieval, capping to inhibit infiltration, monitoring, and long-term management and control (e.g., permanent restricted land use).
- Carbon tetrachloride is the only contaminant that has exceeded its MCL of 5µg/L; currently, levels are below the MCL except at one location (i.e., 5.43 µg/L at Well M7S).



# WAG 7 Aquifer Monitoring Locations



# *WAG 7 Summary*

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- Remediation is ongoing at RWMC
  - Targeted waste retrieval
  - Vapor vacuum extraction and treatment to remove and destroy VOCs
  - Monitoring.
- Carbon tetrachloride slightly exceeds its MCL in one location.
- Surveillance monitoring will continue throughout remediation and after the cap is constructed.



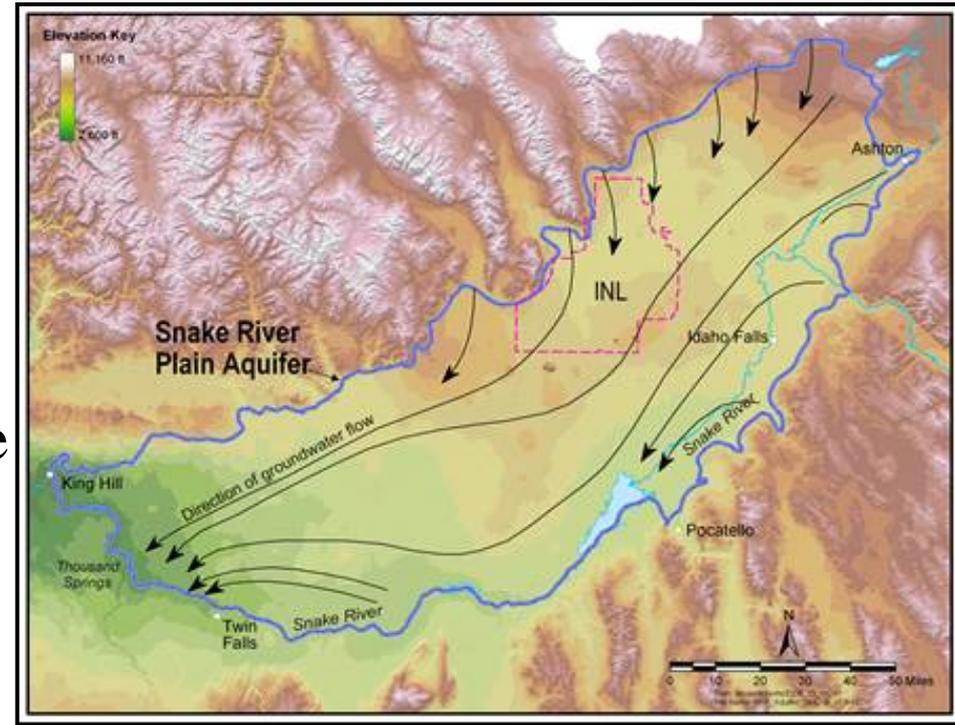
# WAG 10 – INL Site-wide Groundwater

## Current Scope:

- Monitor groundwater at and near southern INL Site boundary.

## Groundwater Contaminants

- VOCs: carbon tetrachloride ( $\text{CCl}_4$ ), trichloroethylene (TCE), and methylene chloride ( $\text{CH}_2\text{Cl}_2$ ).
- Mobile fission and activation products: tritium, strontium-90 (Sr-90), iodine-129 (I-129), and technetium-99 (Tc-99).
- Nitrate.



# ***OU 10-08 Background***

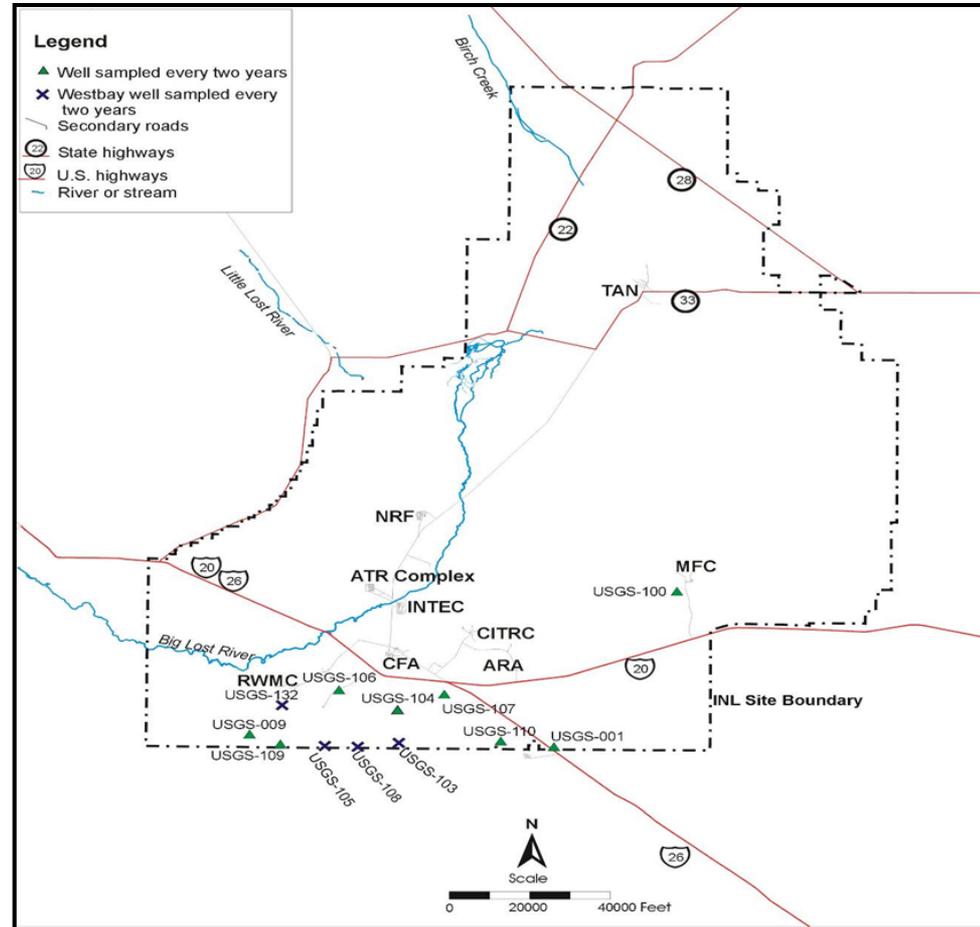
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- Boundary of WAG 10 is INL Site border or beyond as necessary to encompass real or potential impacts from INL Site activities.
- Remedial investigation (RI) assessed:
  - Current risk at the INL Site boundary
  - Future risk on and off the INL Site by modeling potential for commingled plumes.
- RI determined groundwater plumes do not commingle and modeling predicted that commingling would not occur off Site.



# *INL Site-wide Groundwater Monitoring*

- Groundwater leaving the INL Site meets drinking water standards for all analytes.
- Long-term groundwater monitoring will ensure continued protection of off-Site residents and the environment.
- Aquifer contaminant concentrations on the INL Site are expected to decrease over time due to cleanup actions at other WAGs.



## *Dashboard Summary*

<b>Key Questions</b>	<b>Dashboard Indicator</b>	<b>Comments</b>
Impact on budget for activity/cleanup		Project continues to be ahead of schedule and has come in under budget for FY-13 and 1Q FY-14
Impact on employment/economic development		CH2M-WG Idaho, LLC (CWI) has maintained employment for ER activities
Affect on agreements		Milestones have been met in accordance with the FFA/CO and supporting documents
Impact on safety and environment		Cleanup activities and groundwater monitoring continue to progress
Impact on cleanup DOE-wide		Cleanup accomplishments reflect positively on DOE complex



# Acronyms

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Am	americium	ISB	in situ bioremediation
ATR	Advanced Test Reactor (Complex)	INL	Idaho National Laboratory
C	carbon	MCL	maximum contaminant level
CCl <sub>4</sub>	carbon tetrachloride	MNA	monitored natural attenuation
CH <sub>2</sub> Cl <sub>2</sub>	methylene chloride	NPTF	New Pump and Treat Facility
CFA	Central Facilities Area	OU	operable unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PCE	tetrachloroethylene
Cr	chromium	pCi/L	picocurie per liter
Cs	cesium	Pu	plutonium
CWI	CH2M-WG Idaho, LLC	RI	remedial investigation
DCE	dichloroethene	ROD	record of decision
DOE	Department of Energy	RWMC	Radioactive Waste Management Complex
EPA	Environmental Protection Agency	SRPA	Snake River Plain Aquifer
ER	Environmental Restoration	Sr	strontium
FFA/CO	Federal Facility Agreement and Consent Order	TAN	Test Area North
FY	fiscal year	Tc	technetium
H-3	tritium	TCE	trichloroethylene
Hg	mercury	µg/L	micrograms per liter
I	iodine	VC	vinyl chloride
ICP	Idaho Cleanup Project	VOC	volatile organic compound
INTEC	Idaho Nuclear Technology and Engineering Center	WAG	waste area group



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