VOLUME I
CHAPTERS 1 THROUGH 12

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FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE RECAPITALIZATION OF INFRASTRUCTURE SUPPORTING NAVAL SPENT NUCLEAR FUEL HANDLING

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FINAL
Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

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ABSTRACT:

The Naval Nuclear Propulsion Program (NNPP), also known as the Naval Reactors Program, is a joint United States (U.S.) Navy and Department of Energy (DOE) organization with responsibility for all matters pertaining to naval nuclear propulsion from design through disposal (cradle-to-grave). The NNPP's mission is to provide the U.S. with safe, effective, and affordable naval nuclear propulsion plants and to ensure their continued safe and reliable operation through lifetime support, research and development, design, construction, specification, certification, testing, maintenance, and disposal.

This Environmental Impact Statement (EIS) evaluates the potential environmental impacts associated with recapitalizing the infrastructure needed to ensure the long-term capability of the NNPP to support naval spent nuclear fuel handling for at least the next 40 years (i.e., the proposed action). The NNPP is committed to managing naval spent nuclear fuel in a manner that is consistent with the *Department of Energy (DOE) Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (*DOE/EIS-0203-F) and to complying with the 1995 Settlement Agreement, as amended in 2008, among the State of Idaho, the DOE, and the Navy concerning the management of naval spent nuclear fuel.

Consistent with the Record of Decision for DOE/EIS-0203-F, naval spent nuclear fuel is shipped by rail from shipyards and prototypes to the Expended Core Facility (ECF) on the Idaho National Laboratory for processing. The proposed action is needed because significant upgrades are necessary to the ECF infrastructure to continue safe and environmentally responsible naval spent nuclear fuel handling until at least 2060.

To allow the NNPP to continue to unload, transfer, prepare, and package naval spent nuclear fuel for disposal, three alternatives were identified and are evaluated in this EIS:

1. No Action Alternative – Maintain the naval spent nuclear fuel handling capabilities of ECF by continuing to use the current ECF infrastructure while performing only preventative and corrective maintenance.

2. Overhaul Alternative – Recapitalize the naval spent nuclear fuel handling capabilities of ECF by overhauling ECF with major refurbishment projects for the ECF infrastructure and water pools to keep the infrastructure and water pools in safe working order and provide the needed long-term capabilities for transferring, preparing, and packaging naval spent nuclear fuel.

3. New Facility Alternative – Recapitalize the naval spent nuclear fuel handling capabilities of ECF by constructing and operating a new facility at one of two potential locations at the Naval Reactors Facility (NRF).

This EIS evaluates the environmental impacts (direct, indirect, and cumulative) that result from recapitalizing the naval spent nuclear fuel handling capabilities. The EIS presents a comparison of the environmental impacts from these alternatives. The impacts to human health and the environment for all these alternatives would primarily be small. The preferred alternative to recapitalize naval spent nuclear fuel handing capabilities is to build a new facility (New Facility Alternative) at Location 3/4.

SCOPING PROCESS:

The DOE published a Notice of Intent (NOI) to prepare an EIS for naval spent nuclear fuel handling and examination recapitalization in 75 Fed. Reg. 42082 (July 20, 2010). The purpose of this NOI was to announce the NNPP's intent to prepare an EIS for the recapitalization of the infrastructure supporting naval spent nuclear fuel handling and examination and to solicit comments on the scope of the EIS.

During preparation of the Draft EIS, it was determined that the NNPP plan for a single EIS that addressed the recapitalization of the infrastructure supporting both naval spent nuclear fuel handling and examination was not feasible. When the EIS was initially scoped in 2010, the NNPP plans showed the evaluation of alternatives for examination recapitalization being developed in parallel with the development of the Draft EIS such that planning for the recapitalization of the examination capabilities would closely follow planning for the recapitalization of the naval spent nuclear fuel handling capabilities. However, due to fiscal restraints on the DOE budget, project schedules changed such that the proposed action progressed further than evaluations for examination recapitalization. The examination recapitalization evaluations have not developed at a pace sufficient to conduct a proper National Environmental Policy Act (NEPA) evaluation concurrent with the proposed action. A final set of alternatives for the examination recapitalization has not been established, and pre-conceptual design information is not available upon which impacts can be evaluated. An amended NOI was published in 77 Fed. Reg. 27448 (May 10, 2012). The purpose of the amended NOI was to announce the NNPP's intent to reduce the scope of the EIS to include only the recapitalization of naval spent nuclear fuel handling capabilities in the proposed action. The NNPP used the input received during both scoping periods to prepare the Draft EIS.

PUBLIC COMMENT ON THE DRAFT EIS:

On June 19, 2015 the NNPP published a notice announcing the availability of the Draft EIS; the duration of the public comment period through August 10, 2015; the location and timing for three public hearings; and the various methods that could be used for submitting comments on the Draft EIS (80 Fed. Reg. 35331). In response to a request from the Shoshone-Bannock tribes, on

August 14, 2015 the NNPP published a notice that it was reopening the public comment through August 31, 2015 (80 Fed. Reg. 48850).

Three public hearings were held in Idaho from August 4 through August 6, 2015 in Idaho Falls, Pocatello, and Twin Falls. Elected officials and members of the public provided oral and written comments during hearings. Additionally, a website (www.ecfrecapitalization.us) was established to provide further information to the public about the Draft EIS, how to submit comments, and other pertinent information.

All written public comments received plus a transcript of oral comments made during the public hearings are included in Appendix G. Responses to all comments are also included in Appendix G. All comments were considered in preparing this Final EIS.

CHANGES TO THE DRAFT EIS:

Throughout this Final EIS, text revisions and modifications that have occurred since publication of the Draft EIS are indicated by a vertical line (sidebar) in the margin. Section 1.7 provides a summary of the important changes made since the Draft EIS. Other changes were made to update information and make other minor clarifications and editorial revisions. Appendix G does not contain any side-barred text, since that Appendix is an entirely new section of the EIS and did not appear in the Draft EIS.

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ACRONYMS

AEA	Atomic Energy Act
ALARA	As Low As Reasonably Achievable
AQRVs	Air Quality Related Values
ARF	Airborne Release Fraction
ATR	Advanced Test Reactor
B.A.	Bachelor of Arts
BEA	Bureau of Economic Analysis or Battelle Energy Alliance
BLM	Bureau of Land Management
B.S.	Bachelor of Science
CAA	Clean Air Act
CCA	Candidate Conservation Agreement
CED	Committed Effective Dose
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFA	Central Facilities Area
C.F.R.	Code of Federal Regulations
CH	Contact-handled
CRMP	Cultural Resources Management Plan
CSRF	Cask Shipping and Receiving Facility
CT	Computed Tomography
CVN	Carrier Vessel - Nuclear
DART	Days Away, Restricted, or on-the-job Transfer
D&D	Decontamination and Decommissioning
dBA	Decibels on an A-Weighted Scale
DI	Deionized (water)
DOE	Department of Energy
DOP	Dioctylphthalate
DOT	Department of Transportation
DR	Damage Ratio
EA	Environmental Assessment
EBR	Experimental Breeder Reactor
ECF	Expended Core Facility
ED	Effective Dose
EDG	Emergency Diesel Generator
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
EF	Emission Factor
EIS	Environmental Impact Statement
EMR	Environmental Monitoring Report
EO	Executive Order
EPA	Environmental Protection Agency
EPCM	Engineering Procurement and Construction Management
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESER	Environmental Surveillance, Education and Research
ESRP	Eastern Snake River Plain
FFA/CO	Federal Facility Agreement and Consent Order
FFCA	Federal Facilities Compliance Act
FLM	Federal Land Manager
FONSI	Finding of No Significant Impact
FY	Fiscal Year

ACRONYMS (cont.)

GHG	Greenhouse Gas
GTCC	Greater Than Class C
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HDPE	High Density Polyethylene
HEPA	High-Efficiency Particulate Air
HFC	Hydrofluorocarbon
HVAC	Heating, Ventilation and Air Conditioning
ICDC	Idaho Conservation Data Center
ICMR	Institutional Control Monitoring Report
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission on Radiological Protection
IDA	Intentionally Destructive Act
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IFWO	Idaho Fish and Wildlife Office
INEEL	Idaho National Engineering and Environmental Laboratory
INL	Idaho National Laboratory
INPS	Idaho Native Plant Society
INTEC	Idaho Nuclear Technology and Engineering Center
IWD	Industrial Waste Ditch
J.D.	Juris Doctorate (Law Degree)
LA	License Application
LCC	Lambert Conformal Conic
LLW	Low-Level (Radioactive) Waste
LNT	Linear-non-threshold
LPF	Leak Path Factor
LTEM	Long Term Ecological Monitoring
LS	Limit State
M.A.	Master of Arts
MACT	Maximum Achievable Control Technology
MAP	Mitigation Action Plan
MAR	Material-At-Risk
M.B.A.	Master of Business Administration
MCL	Maximum Contaminant Level
MCW	Maximally-Exposed Co-Located Worker
MDL	Method Detection Limit
MEI	Maximally Exposed Off-site Public Individual (INL)
MEng	Master of Engineering
MFC	Materials and Fuels Complex
MLLW	Mixed Low-Level (Radioactive) Waste
MOI	Maximally Exposed Off-site Individual (NRF)
M.S.	Master of Science
MT CO_2e	Metric Tons of CO_2 Equivalent
MTHM	Metric Tons of Heavy Metal
MWMP	Mixed Waste Management Plan
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants

ACRONYMS (cont.)

NHPA	National Historic Preservation Act
NLCD	National Land Cover Data
NNPP	Naval Nuclear Propulsion Program
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPA	Nearest Public Access individual
NPDES	National Pollutant Discharge Elimination System
NPH	Natural Phenomenon Hazard
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
OLM	Ozone Limiting Method
OSB	Overpack Storage Building
OSE	Overpack Storage Expansion
OSHA	Occupational Safety and Health Administration
PAG	Protective Action Guideline
PC	Performance Category
PCB	Polychlorinated Biphenyl
PCS	Primary Constituent Standard
PFC	Perfluorocarbon
Ph.D.	Doctorate of Philosophy
PM	Particulate Matter
PSD	Prevention of Significant Deterioration
PSHA	Probabilistic Seismic Hazard Analysis
RCRA	Resource Conservation and Recovery Act
RF	Respirable Fraction
RH	Remote-handled
ROD	Record of Decision
ROI	Region of Influence
RWMC	Radioactive Waste Management Complex
SA	Supplemental Analysis
SBTC	Shielded Basket Transfer Container
SDC	Seismic Design Category
SDWA	Safe Drinking Water Act
SFPF	Spent Fuel Packaging Facility
SGCA	Sage-grouse Conservation Area
SHPO	State Historic Preservation Office
SI	International System of Units
SOX	Stand-Off Experiment
SRPA	Snake River Plain Aquifer
SRS	Savannah River Site
SSCs	Structures, Systems, and Components
STC	Shielded Transfer Container
STP	Site Treatment Plan
TAN	Test Area North
TAP	Toxic Air Pollutants
TED	Total Effective Dose
TRC	Total Recordable Cases

ACRONYMS (cont.)

TREAT	Transient Reactor Test Facility
TRU	Transuranic
TSCA	Toxic Substances Control Act
U.S.	United States
USACOE	United States Army Corps of Engineers
U.S.C.	United States Code
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound
VRM	Visual Resource Management
WAG	Waste Area Group

CONVERSION CHART

Metric to English / **English to Metric**

Area

Multiply	by	To Find	Multiply	by	To Find
square kilometers	0.386	square miles	square miles	2.590	square kilometers
square meters	10.764	square feet	square feet	0.093	square meters
hectares	2.471	acres	acres	0.405	hectares

Length

Multiply	by	To Find	Multiply	by	To Find
centimeters	0.394	inches	inches	2.540	centimeters
meters	3.281	feet	feet	0.305	meters
kilometers	0.621	miles	miles	1.609	kilometers

Volume

Multiply	by	To Find	Multiply	by	To Find
liters	0.264	gallons	gallons	3.785	liters
cubic meters	1.308	cubic yards	cubic yards	0.765	cubic meters

Weight/Mass

Multiply	by	To Find	Multiply	by	To Find
metric tons	1.102	U.S. tons (short)	U.S. tons (short)	0.907	metric tons
kilograms	0.001102	U.S. tons (short)	U.S. tons (short)	907.185	kilograms
kilograms	2.205	pounds	pounds	0.4536	kilograms
grams	0.0353	ounces	pounds	453.59	grams
grams	0.0022	pounds	ounces	28.35	grams

Temperature

Multiply	by	To Find	Multiply	by	To Find
[degrees Kelvin - 273.15]	1.8, then add 32	degrees Fahrenheit	[degrees Fahrenheit - 32]	0.556, then add 273.15	degrees Kelvin
degrees Celsius	1.8, then add 32	degrees Fahrenheit	[degrees Fahrenheit - 32]	0.556	degrees Celsius

Units of Radiation

1 Curie	=	3.7×10^{10} disintegrations per second
1 Curie	=	3.7×10^{10} Becquerels
1 Becquerel	=	1 disintegration per second
1 rad	=	0.01 gray
1 rem	=	0.01 Sievert
1 gray	=	1 joule per kilogram

Metric to Metric

metric ton	=	1000 kilograms

English to English

U.S. ton (short)	=	2000 pounds
U.S. ton (long)	=	2240 pounds

Metric Prefixes

mega	=	multiplication factor of 1,000,000 (1×10^{6})
kilo	=	multiplication factor of 1,000 (1×10^{3})
centi	=	multiplication factor of 0.01 (1×10^{-2})
milli	=	multiplication factor of 0.001 (1×10^{-3})
micro	=	multiplication factor of 0.000 001 (1×10^{-6})
pico	=	multiplication factor of 0.000 000 000 001 (1×10^{-12})

1.0 INTRODUCTION

The United States (U.S.) Department of Energy (DOE) is evaluating its options for recapitalizing the current naval spent nuclear fuel handling capabilities provided by the Expended Core Facility (ECF) at the Naval Reactors Facility (NRF) such that these capabilities are available through at least 2060. These facilities are located on the Idaho National Laboratory (INL) in the southeastern part of the state of Idaho (Figure 1.1-1). Prepared in accordance with the National Environmental Policy Act (NEPA) and its implementing regulations in 10 C.F.R. § 1021 and 40 C.F.R. § 1500-1508, this Environmental Impact Statement (EIS) provides background information on ECF recapitalization alternatives, describes the affected environment, and analyzes the potential environmental impacts of the alternatives.

1.1 Background

The Naval Nuclear Propulsion Program (NNPP), also known as the Naval Reactors Program, was established in 1948 and is a joint U.S. Navy and DOE organization with responsibility for all matters pertaining to naval nuclear propulsion from design through disposal (cradle-to-grave). The integrated relationship, authorities, and responsibilities between the DOE and U.S. Navy for naval nuclear propulsion are specified in Executive Order 12344, as codified in 50 U.S.C. § 2511 and 50 U.S.C. § 2406. Accordingly, the NNPP's mission is to provide the U.S. with safe, effective, and affordable naval nuclear propulsion plants and to ensure their continued safe and reliable operation through lifetime support, research and development, design, construction, specification, certification, testing, maintenance, and disposal.

A crucial component of the NNPP mission, naval spent nuclear fuel handling, occurs at the end of a nuclear propulsion system's useful life or when naval nuclear fuel has been depleted. At this point, the NNPP is responsible for removal of the naval spent nuclear fuel through a defueling or refueling operation. Both operations remove the naval spent nuclear fuel from the reactor, but a refueling operation also involves installing new fuel, allowing the nuclear-powered ship to be redeployed into the U.S. Navy fleet. Once the naval spent nuclear fuel has been removed from an aircraft carrier, submarine, or prototype, it is sent to NRF for examination and further naval spent nuclear fuel handling, including transferring, preparing, and packaging for transfer to an interim storage facility or geologic repository.

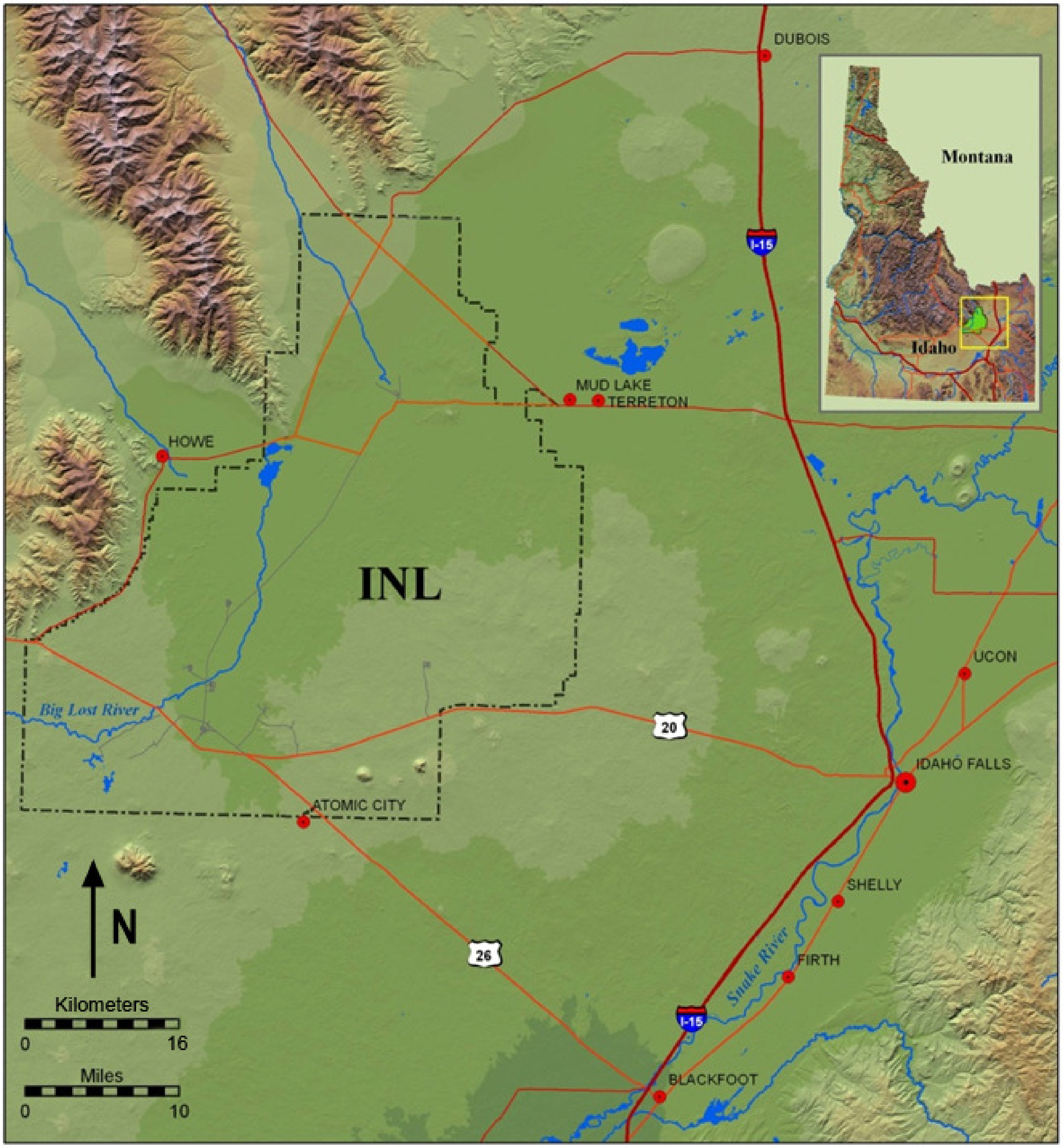


Figure 1.1-1: Idaho National Laboratory in Idaho

1.1.1 Overview of the Naval Nuclear Propulsion Program

U.S. Navy warships provide a credible forward presence around the world every hour of every day, ready to respond on the scene wherever U.S. interests are threatened. Nuclear propulsion plays an essential role in this task, providing the mobility, flexibility, and endurance the U.S. Navy requires to meet a growing number of missions. More than 40 percent of the U.S. Navy's major combatants are nuclear-powered aircraft carriers and submarines.

The NNPP maintains a proven record of over 154 million miles (248 million kilometers) safely traveled on nuclear power and over 55 years of naval nuclear reactor operation without a reactor accident or release of radioactivity that has adversely affected human health or quality of the environment. The NNPP currently operates 97 nuclear reactors and has accumulated over 6600 reactor-years of operation of naval reactors (NNPP 2014). Fundamental to these accomplishments is the NNPP's commitment to stringent standards and robust design and engineering work, which ensure that naval reactor cores perform safely in harsh military applications. Naval reactor cores are designed, built, and tested to ensure that no radioactive fission products are released from their nuclear fuel structure. The integrity and long life of naval fuel is attributed, in part, to a long-standing program of examining naval spent nuclear fuel after it is removed from the reactor. This important process provides data to support development and advancement of nuclear reactor core technology and the ability to address emergent questions related to operating naval reactor cores.

1.1.2 Naval Spent Nuclear Fuel

The reactor core consists of naval fuel assemblies that range in number depending on reactor size and the design of the reactor and fuel assemblies. Naval fuel assemblies are constructed in many configurations, but they generally consist of the fuel, cladding, and structural hardware.

Naval fuel is designed to meet the very stringent operational requirements for naval nuclear propulsion plants and to operate in a high-temperature and high-pressure environment for many years. Current submarine designs are capable of over 30 years of successful operation. Nuclear-powered aircraft carriers can operate free from the need for propulsion fuel replenishment for over 20 years. Naval fuel uses highly corrosion-resistant materials for fuel and cladding which can withstand high-intensity radiation and harsh environments. Naval fuel assemblies retain fission products within the cladding.

Naval spent nuclear fuel consists of solid metal and metallic components that are nonflammable, highly corrosion-resistant, and neither pyrophoric, explosive, combustible, chemically reactive, nor subject to gas generation by chemical reaction or off-gassing. Naval spent nuclear fuel is primarily from pressurized water reactors (PWRs).

Naval nuclear fuel is highly enriched (approximately 93 weight percent to 97 weight percent) in the isotope uranium-235 (^{235}U). As a result of the high initial uranium enrichment, very small amounts of transuranic radionuclides are generated by end of life when compared to commercial spent nuclear fuel.

The ruggedness of naval fuel is demonstrated by the fact that environmental monitoring of the USS THRESHER and USS SCORPION, lost at sea in the 1960's, shows no release of fission products from the fuel despite the catastrophic nature of the loss of these submarines (NNPP 2011a).

Nuclear reactors use the fission process to generate heat and produce steam. The steam drives the propulsion turbines (which turn the propellers) and the turbine generators (which supply electricity) on submarines and aircraft carriers. After their useful life, fuel assemblies are withdrawn from the reactor. At this point, the fuel, together with its cladding, is called naval spent nuclear fuel.

When initially removed from a reactor, spent nuclear fuel is highly radioactive. A fraction of the initial mass of fissionable material (^{235}U) has been converted into fission products, some of which are radioactive, with half-lives ranging from a fraction of a second to thousands of years. At the time of withdrawal from the reactor, most of the radioactivity comes from fission products with short half-lives. The radioactivity of spent nuclear fuel decreases rapidly over time. After 1 year, the radiation levels are about 1 percent of the levels present at the time of removal. After 10 years, these radiation levels decrease by an additional factor of ten. Radioactive decay also generates heat called decay heat. The amount of decay heat generated decreases with time consistent with the decrease in radiation.

The source of most radioactive contamination from routine naval spent nuclear fuel handling operations is from corrosion products that were activated by radiation. Although the corrosion products tightly adhere to the outside surface of naval spent nuclear fuel, some corrosion products may become dislodged from the naval spent nuclear fuel during shipment or handling.

Gamma rays are the radiation of most concern from spent nuclear fuel. Although the radiation levels can be very high, the gamma ray intensities are reduced by shielding spent nuclear fuel with materials such as concrete, lead, steel, and water. The thickness of the required shielding is dependent on the energy of the radiation source, the desired protection level, and the density of the shielding material. Typically, shielding thicknesses for concrete, lead, or steel are much smaller than for water.

1.1.3 Naval Spent Nuclear Fuel Handling and Management

Since 1957, naval spent nuclear fuel removed from naval reactors at shipyards or prototypes has been transferred to specially designed shipping containers and transported to NRF at INL via rail. The shipping containers are staged on rail sidings located inside the developed area of NRF, then transferred to ECF. Access to ECF for these large shipping containers is provided by large roll-up doors. The naval spent nuclear fuel is removed from the shipping containers and placed into a water pool at ECF, where it is stored in temporary storage ports. The fuel assemblies are removed from the shipping containers one at a time, using a shielded fuel handling machine which draws the assembly out of the container. The entire machine is then transferred to the water pools, and the naval spent nuclear fuel assemblies are discharged into the water pools. The water provides: (1) shielding from radiation, (2) visibility to perform re-sizing and disassembly operations necessary for visual examination and packaging, and (3) cooling for decay heat. In addition, the water pool prevents the spread of contamination to the surrounding environment.

At a minimum, each naval spent nuclear fuel assembly receives a visual examination to confirm that the assembly performed as designed, and to look for evidence of unusual conditions such as unexpected corrosion, unexpected wear, or structural defects. Approximately 15 to 20 percent of naval cores receive additional detailed examination and testing in shielded cells. After examination, the naval spent nuclear fuel is prepared for packaging and placed in a naval spent nuclear fuel canister. The naval spent nuclear fuel canister is then loaded into a concrete overpack for dry storage until it can be shipped to an interim storage facility or a geologic repository. A computer-based fuel accountability system maintains a record of the location and type of every piece of nuclear fuel and how many grams of uranium are contained within the fuel.

Naval spent nuclear fuel assemblies have non-fuel-bearing structural components above and below the fuel region to maintain proper support and spacing within the reactor. Generally, these upper and lower non-fuel-bearing structural components are removed in preparation for packaging. Non-fuel structural material is removed in the ECF water pools using an underwater cutting saw in a process known as resizing. The non-fuel-bearing structural material removed from naval spent nuclear fuel assemblies is classified as low-level radioactive waste (LLW). Based upon the radiation levels exhibited by LLW, this waste is designated either as remote-handled (RH) or contact-handled (CH) LLW.

Neutron poison absorbs neutrons to ensure nuclear fission does not occur. When necessary to reduce reactivity, neutron poison material is inserted into the naval spent nuclear fuel assembly.

Once neutron poison materials are inserted or secured, and non-fuel-bearing structural components are removed, the naval spent nuclear fuel assemblies are packaged into stainless steel naval spent nuclear fuel canisters. Then the naval spent nuclear fuel canisters are placed inside concrete overpacks for temporary dry storage. When an interim storage facility or a geologic repository is available to receive naval spent nuclear fuel, the naval spent nuclear fuel canisters will be removed from the concrete overpacks and loaded into M-290 shipping containers for transport.

Naval spent nuclear fuel handling requires stringent controls to protect workers, the public, and the environment. The effectiveness of these stringent radiological control practices has been proven and documented (NNPP 2011a). The following discussion outlines some of the NNPP's practices for controlling radioactivity.

Surface Contamination

Some of the most restrictive practices in the NNPP's radiological control program are those established for controlling radioactive contamination. The NNPP limits the need for anti-contamination clothing by containing radioactivity so personnel cannot come in contact with it. Another basic requirement of contamination control is monitoring all personnel leaving an area where radioactive contamination could possibly exist. This confirms that contamination has not been spread.

Work surfaces are designed to be easily cleaned (plastic or sheet metal containments) to aid in fast and effective cleanup. Work surfaces are decontaminated during and after work to maintain positive contamination control. Frequent contamination surveys are conducted during work evolutions. Results of these surveys are reviewed by supervisory personnel to ensure that no abnormal conditions exist. The instruments used for these surveys are checked for operability against a radioactive source daily, and they are calibrated at least every twelve months.

Radiological Control Practices

In addition to the contamination control practices listed above, several other key radiological control practices used by the NNPP provide additional assurance that positive control of radioactivity is maintained. As previously described, naval spent nuclear fuel is placed inside shielded containers or structures, such as shielded cells or water pools. This lowers general area radiation levels and prevents radioactive contamination from entering the workplace or environment, allowing workers to be stationed in close proximity while performing naval spent nuclear fuel handling operations. Supervisory, quality assurance, and oversight personnel are present in the workplace during these operations to observe work in progress, and to ensure that the work is performed in accordance with the procedures.

1.1.4 NRF and ECF

Location

ECF is located within NRF, which is within the boundaries of INL. The NRF is operated by the NNPP. The developed area of NRF is approximately 34 hectares (84 acres). Figure 1.1-2 provides the location of NRF on INL.

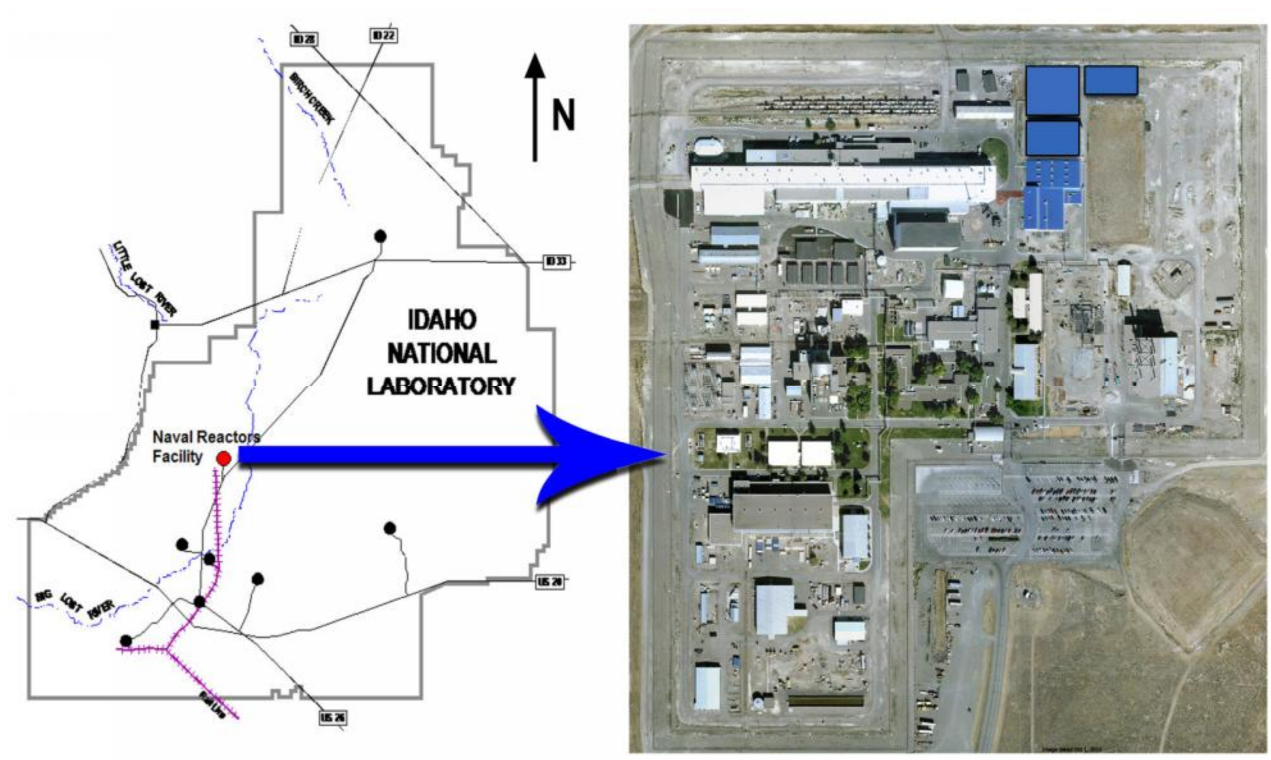


Figure 1.1-2: The NRF Site at INL

Major Structures

The major structures at NRF include: deactivated and defueled naval reactor prototypes; ECF; facilities that interface with ECF (Spent Fuel Packaging Facility (SFPF), Overpack Storage Building (OSB), Overpack Storage Expansions (OSEs), and Cask Shipping and Receiving Facility (CSRF)); and supporting infrastructure, such as warehouses, office buildings, roadways, and utility systems.

The main structures within ECF are shielded cells and interconnected water pools. The water pools provide the capabilities to perform underwater examinations and prepare naval spent nuclear fuel for packaging in naval spent nuclear fuel canisters while providing radiation shielding for workers. There are approximately 1000 storage ports in the ECF water pools. Adjacent to the water pools, the shielded cells provide the capabilities to perform dry examinations on naval spent nuclear fuel and irradiated materials. The ECF water pool area contains various material handling equipment to support operations, including cranes and transfer carts. This equipment is vital to supporting naval spent nuclear fuel handling operations.

Walls and stainless steel gates divide the water pools into smaller work areas, or zones. This partitioning makes it possible to drain a small portion of the total water pool or isolate an individual volume when maintenance or repair is required. The water pool walls and floors are covered with a fiberglass or epoxy coating which is highly resistant to radiation damage, easy to decontaminate, and serves as an extra barrier to water leakage.

Radioactive contaminants that accumulate in the ECF water pools are removed by various filtration techniques, such as: (1) use of water purification modules, (2) water pool surface skimming to remove film and floating material, and (3) water recycling systems. These filtration techniques maintain water clarity, minimize the amount of radioactive contaminants in the water, and are designed to prevent discharges of radioactive material to the environment.

Once the naval spent nuclear fuel has been examined and prepared for packaging, the naval spent nuclear fuel is loaded and packaged into a naval spent nuclear fuel canister for disposal. The SFPF provides the capabilities to load and package the naval spent nuclear fuel canister and load the naval spent nuclear fuel canister into a concrete overpack. The OSB and OSEs provide the capabilities to temporarily dry store the loaded naval spent nuclear fuel canisters inside concrete overpacks. The CSRF provides the capability to remove the naval spent nuclear fuel canisters from the concrete overpacks and load the canisters into an M-290 shipping container for transport to an interim storage facility or a geologic repository for disposal. The CSRF also provides the capability to unload naval spent nuclear fuel not yet examined and prepared for disposal from the M-290 shipping containers for direct placement in temporary dry storage prior to temporary wet storage, and the ability to prepare the empty M-290 shipping containers for return to the shipyards or prototypes.

History and Currently Planned Actions

Operations to support development of naval nuclear propulsion systems for submarines and aircraft carriers began at NRF in the 1950s. The earliest NRF structure was a prototype facility constructed to support an experimental submarine core design. Since NRF operations began, three prototype facilities have been constructed at NRF to test naval nuclear reactors and to train U.S. Navy sailors. Before nuclear power operator training at NRF was discontinued in the 1990s, the site was responsible for training more than 39,000 sailors. The prototype reactors at NRF are defueled and deactivated.

A small water pool facility and a single shielded cell were constructed at the first prototype to support development of early naval reactor cores. This water pool facility provided a shielded environment for resizing and disassembling selected naval spent nuclear fuel assemblies for examination. A shielded cell, consisting of thick concrete walls and leaded-glass shielded viewing windows, allowed safe examination of the disassembled naval spent nuclear fuel assemblies in a dry environment. As the NNPP matured from supporting an experimental submarine program to one supporting a fleet of nuclear-powered ships, the need quickly developed for a dedicated facility to handle and examine the naval spent nuclear fuel assemblies. Based on this need, initial ECF construction began in early 1957. Since that time, naval spent nuclear fuel removed from the U.S. Navy's fleet and naval reactor prototypes has been sent to ECF for handling and examination.

The original ECF building was approximately 100 meters (340 feet) long by 60 meters (190 feet) wide with an approximately 18-meter (59-foot) high bay. The building contained a series of shielded cells and a water pool located in the center of the building that was approximately 10 meters (34 feet) wide, 15 meters (50 feet) long, and 6 meters (20 feet) deep. Since the original construction, the size of ECF increased significantly, through a series of expansions necessary to accommodate the expanding mission of the facility. The current water pool was constructed in four stages. The total length of the ECF water pool is now approximately 130 meters (420 feet), with pool depths ranging from approximately 6 to 14 meters (20 to 45 feet). The interconnected, reinforced concrete water pools contain 12.1 million liters (3.2 million gallons) of water, which is cooled to prevent algae growth and enhance clarity. The water levels in the water pools are maintained at a nearly constant level, with alarms to indicate both high-level and low-level conditions. ECF is currently approximately 305 meters (1000 feet) long and 60 meters (190 feet) wide, with an 18-meter (59-foot) high bay running the length of the building. The high bay area enclosing the water pools and servicing areas has four large overhead cranes of 54 to 113 metric ton (60 to 125 U.S. ton) capacity.

Past ECF expansions and additions of naval spent nuclear fuel handling facilities supporting ECF were based on emerging needs and changes in the NRF mission over time. One of the more significant mission changes occurred because of a 1992 DOE decision to discontinue reprocessing of naval spent nuclear fuel at INL. Until then, naval spent nuclear fuel was examined at ECF, structural hardware was removed from naval spent nuclear fuel assemblies, and the remaining portion of the naval spent nuclear fuel assembly was packaged and transported from NRF to another INL facility for reprocessing. When reprocessing was terminated, NRF's mission expanded to include packaging of naval spent nuclear fuel for disposal.

Following the ECF expansions, additional facilities that interface with ECF were constructed to package and temporarily store naval spent nuclear fuel in a dry condition consistent with the 1995 Settlement Agreement and its 2008 Addendum among the State of Idaho, the DOE, and the U.S. Navy (SA 1995 and SAA 2008). The current NRF naval spent nuclear fuel handling infrastructure includes ECF, the OSB, two OSE buildings, the SFPF, and the CSRF (Figure 1.1-3).

The OSB was constructed in 2001 to temporarily dry store naval spent nuclear fuel canisters packaged in concrete overpacks. Temporary dry storage capability is required pending transport of the naval spent nuclear fuel canisters to an interim storage facility or a geologic repository. The OSB has a thick, reinforced concrete floor, with a metal building to protect the overpacks from the elements; it houses approximately 50 concrete overpacks.

The opening of an interim storage site or a geologic repository has been delayed from 2010 as originally planned to beyond 2020. This delay necessitated an expansion to the OSB to continue to meet SA 1995 and SAA 2008 agreements. The first expansion (completed in 2010) is connected to the existing OSB and increased the storage capacity by approximately 70 concrete overpacks. A second storage expansion was completed to meet capacity demands until at least 2020. A third expansion will be necessary to meet capacity demands beyond 2020. Figure 1.1-3 shows the locations of the second and third storage expansions.

In 2003, operations began in an area of NRF that came to be known as the SFPF. This facility supports packaging of naval spent nuclear fuel assemblies into naval spent nuclear fuel canisters, and loading of the naval spent nuclear fuel canisters into concrete overpacks. These capabilities enable naval spent nuclear fuel to be stored, on a temporary basis, in a dry shielded environment pending transport to an interim storage facility or geologic repository. The SFPF is an extension to ECF located at the southeastern end of the facility (Figure 1.1-3), connected to the water pools by a covered water canal.

Today, naval spent nuclear fuel is transported from shipyards and prototypes to NRF in M-140 shipping containers, unloaded in ECF, and transferred to the water pool for examination and preparation for disposal. Consistent with DON 2007, the NNPP began to use the M-290 shipping container to transport naval spent nuclear fuel to NRF in 2016. The M-290 shipping container is used to transport full-length aircraft carrier naval spent nuclear fuel assemblies, without prior disassembly of the non-fuel structural components, from the shipyards to NRF. ECF as currently configured cannot support the loading or unloading of an M-290 shipping container. The CSRF provides the capability to unload aircraft carrier naval spent nuclear fuel without prior disassembly from the M-290 shipping containers for placement directly into temporary dry storage. The naval spent nuclear fuel unloaded from the M-290 in the CSRF will be temporarily stored dry in canisters in concrete overpacks in the OSB or OSE buildings until the fuel can be transferred to a facility with a water pool sized and configured to support unloading fuel from the M-290 shipping container for examination and preparation for disposal. This process allows the M-290 shipping containers to be unloaded and returned empty to the shipyards, meeting the U.S. Navy's defueling and refueling schedules with minimal interruptions to the spent fuel handling operations at NRF. The M-290 shipping container will also be used to transport naval spent nuclear fuel canisters packaged for disposal to an interim storage facility or geologic repository and will be loaded and prepared for shipment in the CSRF. The CSRF is located to the east of the OSE buildings (Figure 1.1-3).

Note: Overpack Storage Expansion #3 is a conceptual facility to be built if needed.

Figure 1.1-3: ECF and Major Naval Spent Nuclear Fuel Handling Support Facilities at NRF

1.2 The Proposed Action: Recapitalize Naval Spent Nuclear Fuel Handling Capabilities

The NNPP is proposing to recapitalize the current naval spent nuclear fuel handling capabilities provided by ECF.

Naval Spent Nuclear Fuel Handling Capabilities

Figure 1.2-1 illustrates major naval spent nuclear fuel handling capabilities that exist at NRF. A detailed description of the capabilities proposed to be recapitalized is provided below. Section 1.5.3 discusses aspects related to the recapitalization project that are considered to be outside the scope of the EIS.

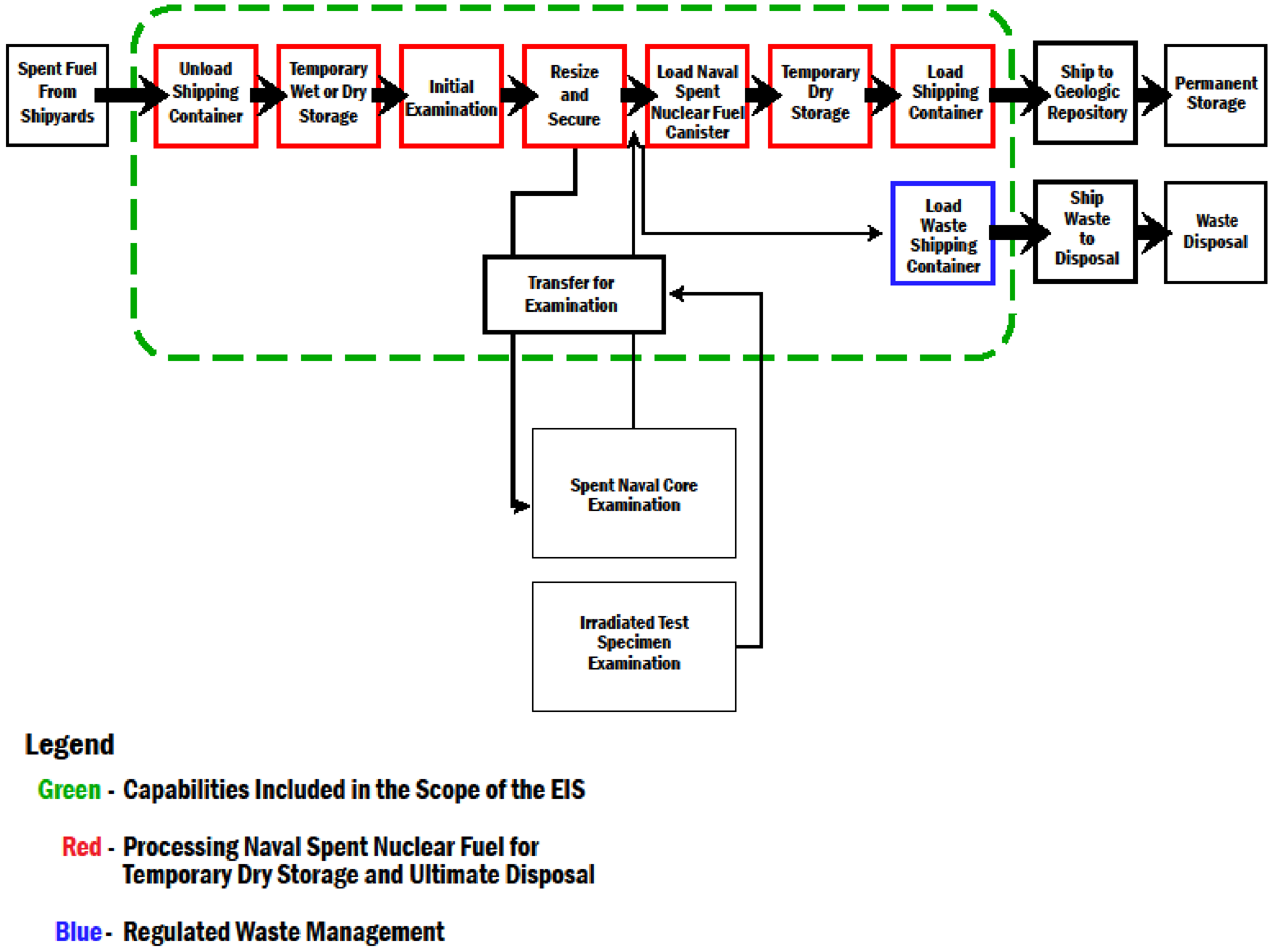


Figure 1.2-1: Naval Spent Nuclear Fuel Handling Capabilities

Unload Shipping Container

Naval spent nuclear fuel is shipped by rail in shipping containers from shipyards and prototypes to ECF. The ability to receive and unload naval spent nuclear fuel from shipyards and prototypes is within the scope of the proposed action.

Temporary Wet or Dry Storage

After unloading naval spent nuclear fuel from the shipping container, the naval spent nuclear fuel is temporarily stored wet in the ECF water pool. The core examination library of naval spent nuclear fuel, core examination specimens, and irradiation test specimens are also stored wet in the ECF water pool. The ability to store naval spent nuclear fuel, core examination specimens, and irradiation test specimens in a wet configuration is within the scope of the proposed action.

Naval spent nuclear fuel may also be unloaded from shipping containers and placed into concrete overpacks in the CSRF for temporary storage in the OSB or OSE buildings. When required, this naval spent nuclear fuel can be reloaded into a shipping container to be transferred to a facility to unload the naval spent nuclear fuel into the water pools for subsequent operations. The ability to unload temporarily dry stored naval spent nuclear fuel into the water pool for subsequent operations is within the scope of the proposed action.

Initial Examination

A visual inspection is performed on each naval spent nuclear fuel assembly before it is prepared for transfer to an interim storage facility or geologic repository. These visual inspections are currently performed in the ECF water pools. The ability to perform visual inspections is within the scope of the proposed action.

Some naval spent nuclear fuel is given more detailed examinations for such purposes as confirming the adequacy of new design features, exploring material performance concerns, and obtaining detailed information to confirm or adjust computer predictions of naval nuclear core performance attributes. These non-destructive examinations, which do not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel, could include detailed visual examinations, dimension measurements, or evaluations of corrosion product build-up. The ability to perform non-destructive examinations in the water pool is within the scope of the proposed action.

Resize and Secure

Naval spent nuclear fuel is prepared for more detailed examination by resizing and for disposal by resizing and inserting or securing neutron poison when necessary. This preparation is currently done in the ECF water pools. The ability to resize naval spent nuclear fuel and install and secure neutron poison is within the scope of the proposed action.

Transfer for Examination

ECF provides the capability to transfer those naval spent nuclear fuel assemblies, core examination specimens, and core components designated for more detailed or destructive examinations to the examination location (e.g., shielded cells in ECF). The ability to transfer naval spent nuclear fuel assemblies, core examination specimens, and core components for more detailed and destructive examination is within the scope of the proposed action.

Load Naval Spent Nuclear Fuel Canister

Naval spent nuclear fuel, core examination specimens, and irradiation test specimens are loaded into naval spent nuclear fuel canisters in the SFPF. The ability to package naval spent nuclear fuel, core examination specimens, and irradiation test specimens into naval spent nuclear fuel canisters is within the scope of the proposed action.

Temporary Dry Storage

Once naval spent nuclear fuel is packaged into naval spent nuclear fuel canisters, the canisters are loaded into concrete overpacks for temporary dry storage. These operations currently take place in the SFPF. Once loaded into concrete overpacks, the overpacks are transferred to the OSB or OSE buildings. The ability to load naval spent nuclear fuel canisters into concrete overpacks and place them in temporary dry storage is within the scope of the proposed action.

Load Shipping Container

Naval spent nuclear fuel canisters will be removed from the concrete overpacks and loaded into M-290 shipping containers in the CSRF to ship to an interim storage facility or a geologic repository for disposal. The ability to unload naval spent nuclear fuel canisters from the concrete overpacks into M-290 shipping containers is within the scope of the proposed action.

Load Waste Shipping Container

Waste is generated at ECF during the process of preparing naval spent nuclear fuel for examination, dry storage, and disposal. The waste is currently packaged into waste shipping containers for shipment from NRF. The infrastructure to manage and package the waste generated during operations, including use of a waste shipping container, is within the scope of the proposed action.

1.3 Purpose and Need for the Proposed Action

The purpose of the proposed action is to provide the infrastructure necessary to support the naval nuclear reactor defueling and refueling schedules required to meet the operational needs of the U.S. Navy. The proposed action is needed because significant upgrades are necessary to the ECF infrastructure to continue safe and environmentally responsible naval spent nuclear fuel handling until at least 2060.

Based on the life-cycle of current and new designs and planned construction of aircraft carriers and submarines, the ability to perform naval spent nuclear fuel handling will be required into the foreseeable future. Next-generation aircraft carriers have a ship life of approximately 50 years, while new nuclear submarines will have operational lives of approximately 30 years. The scheduled delivery for the first next-generation nuclear-powered U.S. Navy aircraft carrier, GERALD R. FORD (CVN 78), is 2016; new nuclear-powered submarines are also under construction. The NNPP must maintain the infrastructure to support naval nuclear reactor defueling and refueling schedules required to meet the operational needs of the U.S. Navy. For example, ECF infrastructure as currently configured cannot support the use of the new M-290 shipping containers. The NNPP is committed to managing naval spent nuclear fuel consistent with DOE 1995 and DOE 1996 and to complying with the naval spent nuclear fuel aspects of SA 1995 and SAA 2008.

The capabilities described in Section 1.2 are vital to the NNPP mission of maintaining the reliable operation of the naval nuclear-powered fleet and developing effective naval nuclear propulsion plants. The NNPP continues to maintain and operate ECF in a safe and environmentally responsible manner. The water in the water pool has excellent water clarity due to the use of a water purification system, and it does not have biological buildup (e.g. algae) due to a cooling system. The radioactivity concentrations in the water pool water are low, and the water pool does not have a buildup of radioactive debris on the water pool floor. An updated seismic analysis of the ECF water pool reinforced concrete structures and adjacent building steel superstructure concluded that the reinforced concrete portion of the water pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a Performance Category 3 structure. The analysis verified that the ECF reinforced concrete pools and adjacent building superstructure would maintain structural stability in a design basis earthquake. Additionally, the ECF overhead cranes were determined to remain on the crane rails during a design basis earthquake. Emergency equipment, systems, procedures, and trained emergency response personnel provide measures to mitigate seismic events.

Outdated designs and upgrades to ECF infrastructure and equipment necessary to continue ECF operations in a safe and environmentally responsible manner present a challenge to the continuity of ongoing ECF naval spent nuclear fuel handling operations. Major portions of the ECF infrastructure have been in service for over 50 years. The maintenance and repair burden necessary to sustain ECF as a viable resource for long-term operations is increasing. The ECF water pools have never undergone a complete refurbishment and have not been upgraded to current seismic standards. The pool does not have a liner, creating the potential for water infiltration into the reinforced concrete structure and the potential for corrosion damage of the reinforcing bar within the structure. The absence of a liner also means the capability to detect and collect small leaks, a common feature in modern water pools, is not present for the ECF water pool. Consequently, while the replacement or overhaul of the current water pool is not a matter of urgency that must be done in a very short period, it is something that needs to be planned and started soon (Section 2.3).

ECF is currently the only industrial base equipped to perform all aspects of naval spent nuclear fuel handling. There are no existing alternative facilities that could be employed effectively if the NNPP's current infrastructure for handling naval spent nuclear fuel becomes unavailable. Without the capabilities of ECF, the U.S. Navy's nuclear-powered fleet defueling and refueling operations would need to be stopped, leading to the inability of the nuclear-powered ships or their nuclear-trained naval personnel to be redeployed into fleet operations. The availability of the nuclear-powered fleet directly affects the ability of the U.S. Navy to meet its military missions, ultimately impacting national security interests.

1.4 NEPA Regulatory Framework and Process

NEPA establishes a national policy of promoting awareness of the environmental impacts of activities by federal government agencies. NEPA requires federal agencies to consider in their decision-making processes: (1) the potential environmental effects of proposed actions, both positive and negative, (2) the analyses of alternatives, and (3) measures to avoid or minimize the adverse effects of a proposed action. Alternatives are a range of reasonable options considered in selecting an approach to meet the proposed action. In accordance with other applicable requirements, a No Action Alternative is also considered.

An EIS is a detailed environmental analysis for a proposed major federal action that could significantly affect the quality of the human environment. A tool to assist in decision-making, an EIS describes the positive and negative environmental effects of the proposed action and alternatives.

The NNPP has determined that the recapitalization of infrastructure supporting naval spent nuclear fuel handling at NRF is a major federal action warranting preparation of an EIS. Many of the naval spent nuclear fuel handling operations currently in use at NRF will continue to be used in the future. This EIS uses the best available information, along with environmental evaluations made in the past (updated where appropriate), to support assessments and conclusions.

1.5 Scope of the EIS

Actions necessary to continue the NNPP's ability to support naval spent nuclear fuel handling described above are the subject of this EIS. In this document, the NNPP assesses the environmental impacts of recapitalizing the infrastructure that currently supports the handling of naval spent nuclear fuel. This EIS reviews: (1) the existing facilities and operations at NRF for handling naval spent nuclear fuel, and (2) the changes necessary to either continue this work in the current facilities or perform it in new facilities. This EIS evaluates the environmental impacts (direct, indirect, and cumulative) that result from recapitalizing the naval spent nuclear fuel handling capabilities. Both radiological and non-radiological impacts are evaluated. This EIS also describes potential mitigation measures that would eliminate or reduce the impacts of proposed actions and monitoring programs that would be used to confirm that these measures are effective.

Per NEPA requirements (10 C.F.R. § 1021 and 40 C.F.R. § 1500–1508), consideration must be given to whether actions performed under the alternatives could result in a violation of any federal, state, or local law or requirements, or require a federal permit, license, or other entitlements. Federal environmental laws that affect environmental protection, health, safety, and compliance were considered in the EIS scope development. In addition, environmental requirements that have been delegated to the state of Idaho and local requirements were considered to ensure compliance. Consideration was also given to comments received during the public scoping period (Section 1.5.1).

1.5.1 Scoping Process

An essential component of the NEPA process is public involvement. During the scoping process, the NNPP solicited public involvement in determining the scope of issues to be addressed and to identify the significant issues that need to be addressed in this EIS. The DOE published a Notice of Intent (NOI) to prepare an EIS for naval spent nuclear fuel handling and examination recapitalization in 75 Fed. Reg. 42082 (July 20, 2010). The purpose of this NOI was to announce the NNPP's intent to prepare an EIS for the recapitalization of the infrastructure supporting naval spent nuclear fuel handling and examination and to solicit comments on the scope of the EIS. NOI publication and public scoping meetings were announced in ten selected newspapers in Idaho and Wyoming to ensure communication with the public. Notifications were also sent to federal officials, state agencies, tribal officials, and citizens groups.

The NOI invited participation in any of three public scoping meetings at the following locations:

Idaho Falls, ID	August 24, 2010
Pocatello, ID	August 25, 2010
Twin Falls, ID	August 26, 2010

The comment period on the scope of the EIS lasted from July 20, 2010 to September 3, 2010.

Naval spent nuclear fuel handling includes the transfer of spent nuclear fuel removed from a naval reactor to NRF, where it is received, unloaded, prepared, and packaged for temporary dry storage and disposal. In addition to preparing naval spent nuclear fuel for disposal, NRF performs detailed destructive and non-destructive examinations on naval spent nuclear fuel, core components, and irradiated test specimens. Recapitalization of both capabilities, naval spent nuclear fuel handling and examinations will eventually be necessary, but neither capability's recapitalization is necessary to the successful use of the other capability.

During preparation of the Draft EIS, it was determined that the NNPP plan for a single EIS that addressed the recapitalization of the infrastructure supporting both naval spent nuclear fuel handling and examination was not feasible. When the EIS was initially scoped in 2010, the NNPP expected the evaluation of alternatives for examination recapitalization would proceed in parallel with the development of the Draft EIS such that planning for the recapitalization of the examination capabilities would closely follow planning for the recapitalization of the naval spent nuclear fuel handling capabilities. However, due to fiscal restraints on the DOE budget, project schedules changed such that the evaluation of the recapitalization of the naval spent nuclear fuel handling capabilities progressed further than evaluations for examination recapitalization. The examination recapitalization evaluations have not developed at a pace sufficient to conduct a proper NEPA evaluation concurrent with the proposed action. A final set of alternatives for the examination recapitalization has not been established, and pre-conceptual design information is not available upon which impacts can be evaluated.

As a result, an amended NOI was published in 77 Fed. Reg. 27448 (May 10, 2012). The purpose of the amended NOI was to announce the NNPP's intent to reduce the scope of the EIS to include only the recapitalization of naval spent nuclear fuel handling capabilities in the proposed action. The amended NOI was published in ten selected newspapers in Idaho and Wyoming to ensure communication with the public. Notifications were also sent to federal officials, state agencies, tribal officials, and citizens groups. The comment period on the reduced scope of the EIS lasted from May 10, 2012 to June 11, 2012.

Comments were received during the initial public scoping period and during the comment period for the amended NOI via U.S. Mail, e-mail, and public meetings. These comments, and the comment responses, are provided in Appendix A of this EIS. The scoping process helped identify those issues requiring in-depth analysis. Such information was used to prepare the Draft EIS.

1.5.2 Application of the Sliding Scale

The sliding scale approach to NEPA analysis implements the Council for Environmental Quality's instruction that in EISs agencies "focus on significant environmental issues and alternatives" (40 C.F.R. § 1502.1) and discuss impacts "in proportion to their significance" (40 C.F.R. § 1502.2(b)). Consistent with this approach, the impacts discussed in Chapter 4 are more extensive for those environmental resources with potential regional effects, potential adverse effects on public and worker health and safety, and potential for cumulative effects. These environmental resources are:

- Geology and Soils
- Water Resources
- Ecological Resources
- Air Quality
- Cultural Resources
- Socioeconomics
- Infrastructure
- Environmental Justice
- Public and Occupational Health and Safety
- Waste Management
- Naval Spent Nuclear Fuel Management

The discussion in Chapter 4 is less extensive for those environmental resources with impacts that are minimal, do not affect the comparison of alternatives, and require less effort to meet the environmental regulations. These resources include:

- Land Use
- Transportation
- Noise
- Visual and Scenic Resources

1.5.3 Issues Outside the Scope of the EIS

Issues outside the scope of this EIS are those that: (1) are not directly or could be reasonably determined to be indirectly impacted by naval spent nuclear fuel handling, or (2) were previously examined in other NEPA documents.

These items include but are not limited to:

Location of the Proposed Action at a Location off INL (e.g., Savannah River Site (SRS))

In the mid-1990s, DOE comprehensively evaluated future management of spent nuclear fuel within the DOE complex (DOE 1995). Based on that evaluation, DOE issued a Record of Decision (ROD) on May 30, 1995 (ROD 1995) to manage existing and newly generated spent nuclear fuel by fuel type at one of three existing DOE facilities: the Hanford site, INL, and SRS. This decision included the continued management of naval spent nuclear fuel by NRF at INL. DOE amended ROD 1995 in ROD 1996 to reflect SA 1995. The amended ROD did not affect the selection of NRF for continued management of naval spent nuclear fuel.

Subsequent actions have further established INL as the lead DOE facility for research, development, and demonstration of nuclear energy technologies. In 1995, DOE designated INL as lead laboratory for spent nuclear fuel. In 1999, the Office of Nuclear Energy, Science and Technology designated INL and Argonne National Laboratory as the lead laboratories for nuclear technology. In 2002, then-DOE Secretary Abraham announced that INL will serve as the lead laboratory and construction site for the Next Generation Nuclear Plant.

As discussed in ROD 1995 and ROD 1996, the programmatic decision to locate naval spent nuclear fuel operations at INL has been made. Therefore, location of the proposed action off the INL is outside the scope of this EIS.

Transportation of Naval Spent Nuclear Fuel From Shipyards and Prototypes to INL and NRF

The proposed action results in no changes to the current process of transporting naval spent nuclear fuel from shipyards and prototypes to NRF. In addition, transporting naval spent nuclear fuel from shipyards and prototypes to INL and NRF was evaluated in DOE 1995. DOE 1995 concluded that human health and environmental impacts from transportation of naval spent nuclear fuel would be small. Transportation of spent nuclear fuel, including naval spent nuclear fuel, has also been evaluated in DOE 1996, DOE 2002a, DOE 2008b, DON 2007, and DON 2009. These additional evaluations have continued to conclude that human health and environmental impacts from transport of spent nuclear fuel would be small. Further, NNPP operational experience supports this conclusion. The NNPP has safely made over 820 container shipments of naval spent nuclear fuel since 1957 using specially designed, rugged containers, such as the M-140 shipping container. Shipments of radioactive materials associated with naval nuclear propulsion plants have not resulted in any measurable release of radioactivity to the environment. There have never been any accidents involving significant release of radioactive material during shipment in the history of the NNPP. Therefore, since the impacts of transportation have been previously analyzed, transportation of naval spent nuclear fuel from shipyards and prototypes to INL is outside the scope of this EIS.

Container System and Location for Dry Storage of Naval Spent Nuclear Fuel

In DOE 1996, the U.S. Navy considered six alternative dry storage container systems for the loading, storage, transport, and possible disposal of naval spent nuclear fuel. The U.S. Navy also evaluated options regarding the location(s) for the loading of naval spent nuclear fuel, currently stored at the Idaho Nuclear Technology and Engineering Center (INTEC), formerly known as the Idaho Chemical Processing Plant (ICPP), into the dry storage container. In addition, DOE 1996 evaluated the location(s) for temporary storage of the containers loaded with naval spent nuclear fuel and special case waste. In doing this evaluation, the U.S. Navy and DOE considered existing facilities at INL, including currently undeveloped locations potentially not above the Snake River Plain Aquifer (SRPA), and assessed the technical feasibility of building a dry storage facility within INL at a point removed from above the SRPA.

The container system chosen in ROD 1997b was a dual-purpose canister system. In a second ROD (ROD 1997a), the U.S. Navy and DOE announced their decision that the naval spent nuclear fuel, which is stored at ICPP, would be loaded into dual-purpose canisters at NRF. The U.S. Navy and DOE announced the additional decision that all dual-purpose canisters loaded with naval spent nuclear fuel would be stored at a site adjacent to ECF at NRF.

The container system and method of preparing naval spent nuclear fuel for temporary dry storage and disposal in the proposed action would be consistent with the method described and analyzed in DOE 1996. In addition, DOE 1996 evaluated the impact of storing all naval spent nuclear fuel generated by 2035 in canisters in storage facilities adjacent to ECF. Consistent with the evaluation and ROD 1997a, the first dry storage facility, known as the OSB, was constructed in 2001, adjacent to ECF. Since 2001, two OSE buildings have been constructed. An additional OSE is planned if needed to accommodate the growing number of concrete overpacks loaded with naval spent nuclear fuel canisters. The temporary dry storage of naval spent nuclear fuel in the OSB and OSEs is consistent with the evaluation in DOE 1996 and enables the NNPP to continue to meet its obligations in SA 1995 (described below) for dry storage. The container system and location for dry storage of naval spent nuclear fuel canisters in concrete overpacks is outside the scope of this EIS.

Disposal of Naval Spent Nuclear Fuel at, and Transportation of Naval Spent Nuclear Fuel to, a National Geologic Repository (e.g., Yucca Mountain)

In July 2002, the President signed into law a joint resolution of the U.S. House of Representatives and the U.S. Senate designating the Yucca Mountain site in Nye County, Nevada, for development as a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste.

Pursuant to the Nuclear Waste Policy Act of 1982, as amended (NWPA, 42 U.S.C. 10101 *et seq.*), and NEPA, DOE issued DOE 2002a. DOE 2002a analyzed a proposed action under which DOE would construct, operate, monitor, and eventually close a geologic repository at Yucca Mountain, including shipment of spent nuclear fuel and high-level radioactive waste from 72 commercial and five DOE sites (including naval spent nuclear fuel from the INL) to the Yucca Mountain geologic repository. DOE evaluated the potential impacts of transporting spent nuclear fuel and high-level radioactive waste to the geologic repository under a variety of modes, including truck and rail. The DOE identified the mostly rail alternative as its preferred mode of transportation, both nationally and in the state of Nevada in DOE 2002a.

The environmental impact evaluations done by the DOE in support of a geologic repository at Yucca Mountain included the impact of disposing and transporting naval spent nuclear fuel. Therefore, the scope of the proposed action does not include transportation of naval spent nuclear fuel to a geologic repository. Based on previous NEPA documentation and the scope of the proposed action, disposal and transportation of naval spent nuclear fuel is outside the scope of this EIS.

The DOE Office of Civilian Radioactive Waste Management submitted a License Application (LA) for a geologic repository at Yucca Mountain, Nevada to the Nuclear Regulatory Commission in June 2008. On March 3, 2010, the DOE filed a motion to withdraw the LA.

The DOE has stated that the proposed geologic repository at Yucca Mountain is not a workable option for storing spent nuclear fuel and nuclear waste generated at nuclear facilities in the U.S. In 2010, the Secretary of Energy chartered the Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review and recommend a plan of action for the management and disposal of the nation's used nuclear fuel and high-level radioactive waste. In BRC 2012, the Blue Ribbon Commission recommended a strategy that has eight key elements:

1. A new, consent-based approach to siting future nuclear waste management facilities.
2. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed.
3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management.
4. Prompt efforts to develop one or more geologic disposal facilities.

5. Prompt efforts to develop one or more consolidated storage facilities.
6. Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available.
7. Support for continued U.S. innovation in nuclear energy technology and for workforce development.
8. Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

In 2013, the DOE published a framework for the DOE to move toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel and high-level radioactive waste (DOE 2013d). This strategy adopted many of the Blue Ribbon Commission's recommendations including a phased, adaptive, and consent-based approach to siting and implementing a comprehensive management and disposal system. The strategy also noted that the policy of "commingling" both commercial and defense wastes would be the subject of additional analysis.

The DOE has begun a consent-based siting process to establish an integrated waste management system to transport, store, and dispose of spent nuclear fuel and high-level waste, 80 Fed. Reg. 79872 (December 23, 2015). During 2016, the DOE is holding meetings around the country to allow the public, communities, states, Tribal Nations, and others to provide input to the DOE on the development of this consent-based siting process.

In addition, the DOE prepared an assessment of disposal options for DOE-managed high-level radioactive waste and spent fuel (DOE 2014f) which recommended that DOE pursue development of a separate repository for some DOE-managed high-level waste and spent nuclear fuel. This would include provisions for disposal of cooler naval spent nuclear fuel. On March 24, 2015 the President issued a finding based upon DOE 2015a that the DOE should pursue development of a separate repository for the disposal of high-level radioactive waste resulting from atomic energy defense activities.

As these two alternative paths for disposal of spent fuel and nuclear waste are further explored in accordance with the recommendations by the Blue Ribbon Commission on America's Nuclear Future (BRC 2012), the NNPP remains committed to supporting SA 1995 and SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to a national geologic repository or interim storage facility will be subject to their own NEPA analysis and are beyond the scope of this EIS. These potential actions would not affect the actions analyzed in this EIS.

Transportation and Disposal of Waste From NRF

The waste generated from the proposed action would be similar to waste generated at NRF today. The transportation and disposal of waste from NRF has been evaluated in several NEPA documents specific to the type of waste being disposed. Because transportation and disposal of waste from INL, including NRF, has been evaluated in various NEPA documents, additional analysis is not provided in this EIS. Descriptions of these NEPA documents are provided below:

- *Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Waste Generated at the Department of Energy's Idaho Site (DOE 2011a)*

Historically, INL has disposed of its RH LLW on-site (decision documented in ROD 1995). However, the existing disposal area located within INL's Radioactive Waste Management Complex (RWMC) will undergo closure as part of the ongoing cleanup of INL. In the Environmental Assessment (EA), the DOE proposes to provide replacement capability for disposal of RH LLW generated at INL beginning in October 2017.

The Advanced Test Reactor (ATR) Complex, Materials and Fuels Complex (MFC), and NRF all generate RH LLW that is currently disposed of at the RWMC. At NRF, the process for preparing naval spent nuclear fuel assemblies involves removing non-fuel-bearing structural components, which are RH LLW that require disposal. Filtration of water in the NRF water pools as part of ongoing maintenance also generates RH LLW.

The proposed action described in the EA is to develop on-site replacement disposal capability at INL, including construction of a new facility specifically designed and operated for the INL site's RH LLW. A Finding of No Significant Impact for this EA (DOE 2011b) determined that the selected action would not significantly affect the quality of the human environment.

- *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (DOE 1997)*

DOE 1997 is a nationwide study examining the environmental impacts of managing five types of radioactive and hazardous wastes generated by past and future nuclear defense and research activities at a variety of sites located around the U.S. The five waste types are Mixed LLW, LLW, Transuranic (TRU) Waste, High Level Waste, and Hazardous Waste. Each waste type has unique physical characteristics and regulatory requirements and accordingly is managed separately. For each waste type, facilities are needed to treat, store, and dispose of the waste.

This document examined, in an integrated fashion, not only the impacts of waste management alternatives for each waste type but also the specific cumulative impacts from all the waste facilities at a given site, across the DOE complex. Impacts associated with constructing and operating treatment, storage, and disposal facilities or transporting waste were also evaluated.

In ROD 2000, DOE decided to perform minimum LLW treatment at all sites and continue, to the extent practicable, disposal of on-site LLW at INL, Los Alamos National Laboratory in New Mexico, Oak Ridge Reservation in Tennessee, and SRS in South Carolina. DOE further decided to dispose of LLW at the Hanford site and Nevada Test Site (now referred to as National Nuclear Security Site). INL and SRS were to continue to dispose of LLW generated by the NNPP.

1.6 Public Comment on the Draft EIS

On June 19, 2015 the NNPP published a notice announcing the availability of the Draft EIS; the duration of the public comment period through August 10, 2015; the location and timing for three public hearings; and the various methods that could be used to submit comments on the Draft EIS (80 Fed. Reg. 35331). In response to a request from the Shoshone-Bannock tribes, on August 14, 2015 the NNPP published a notice that it was reopening the public comment through August 31, 2015 (80 Fed. Reg. 48850).

Three public hearings were held in Idaho from August 4 through August 6, 2015 in Idaho Falls, Pocatello, and Twin Falls. Elected officials and members of the public provided oral and written comments during hearings. Additionally, a website (www.ecfrecapitalization.us) was established to provide further information to the public about the Draft EIS, how to submit comments, and other pertinent information.

1.7 Important Changes From the Draft EIS

Changes to Resolve Public Comments

All written public comments received plus a transcript of oral comments made during the public hearings are included in Appendix G. All comments were considered in preparing this Final EIS. Responses to all comments are included in Appendix G.

As a result of comments, the NNPP added discussion about the characteristics of naval spent nuclear fuel and updated the description of the percentage of naval cores examined in Chapter 1. Chapter 2 was revised to update figures showing rail alignment to better reflect the planned alignment. Chapter 3 was updated to reflect the most recent seismic studies, climate change information, and greenhouse gas emissions. Also a cultural resource map was removed at the request of the Shoshone-Bannock Tribe, as the map displays zones that are modeled to have high or low probabilities of cultural resources. Chapter 4 was revised to update maps to show the latest rail alignment, add additional discussion of climate change and greenhouse gases consistent with NNPP and DOE documents, and to add a description of the NNPP safety design strategy. Chapter 5 was revised to reflect the current status of DOE projects on the INL. Chapter 6 was updated to discuss mitigation measures committed to during consultation and actions where credit is taken to reduce expected impacts. Additional minor clarifications were made as described in Appendix G.

Changes to Reflect Additional Design for the New Facility Alternative

Changes were also made to the Draft EIS as a result of additional design and planning for the New Facility Alternative. The design and planning for a new facility at Location 3/4, the NNPP preferred alternative, has continued to progress consistent with DOE Order 413.3B, Program and Project Management for Acquisition of Capital Assets. The plans for the New Facility Alternative have progressed from the conceptual design stage to preliminary design. Changes to the design and planning for the construction have been identified including changes to the seismic design strategy, storm water management, and potential air emissions as a result of changes in the planned operation of concrete batch plants.

<u>Seismic Design Strategy</u>

The seismic performance of the New Facility Alternative was revised to reflect a more mature facility design and finalized seismic design requirements. The Draft EIS assumed that the New Facility Alternative spent nuclear fuel water pool would be designed and built to the highest seismic design category, which corresponded to a probability of seismic-related failure of 1 in 100,000 per year.

Based on further development of the New Facility Alternative, designing all of the structures surrounding the water pool to this standard would be impractical. Therefore, the Final EIS reflects that both the New Facility Alternative and Overhaul Alternative would be designed and built to meet the DOE requirements, which correspond to a probability of seismic-related failure of 1 in 10,000 per year. The level of conservatism selected appropriately balances protection of facility workers and the public in a seismic event with the use of proven and reliable technology.

In addition, for the New Facility Alternative, major elements of the new facility would be designed and built to exceed DOE requirements. For example, the new facility would include features to enhance the robustness of the spent nuclear fuel water pool concrete structure to withstand the seismic spectra of the highest seismic design category. Surrounding structures would also be designed and built, where practical, to lower the overall probability of seismic-related failure of the facility. These additional features are only practical and cost effective for the New Facility Alternative. As discussed in Section F.5.4.4, the probability of seismic-related failure for the New Facility Alternative in the Final EIS is set at 1 in 14,300 per year (or a probability of 7×10^{-5} per year); the resulting risk is less than the risks from seismic-related failure for the Overhaul Alternative and the No Action Alternative.

There were no changes to the Overhaul Alternative or No Action Alternative seismic-related probability of failure.

Water Management

Retention and evaporation basins would be used in the design of the storm water management systems for storm water runoff for the new facility at Location 3/4 consistent with low impact development techniques. Retention and evaporation basins provide advantages over connection of storm water drains into the existing NRF drainage system that discharges to the IWD. Section 4.4 was updated to describe the revised plans for management of storm water discharges for the New Facility Alternative at Location 3/4. The changes to storm water management for the New Facility Alternative are not expected to result in additional land clearing or other changes to impacts described in Section 4.1.

Water pool design and leak testing methodology was further developed. The preferred method for managing water used to leak test the pools is to move it between gated sections of the pool and not discharge the water to the environment. Alternative methods would be to discharge the water from leak testing the pools (up to 18,927,000 liters (5 million gallons)) to the sewage lagoons or to the IWD during the last year of construction. The preferred location for discharge is to the sewage lagoons (shorter distance, high capacity). Discharge to the IWD would be the last choice. This discharge would occur over a short period of time (about 6 days) but is not expected to exceed the infiltration capacity or the maximum flow distance (2.9 kilometers (1.8 miles)) previously recorded for the IWD. The permitted annual discharge rate for the IWD of 113,600,000 liters (30,000,000 gallons) would not be exceeded. Section 4.4.3 reflects this potential discharge of water for pool leak testing.

Non-Radiological Air Emissions

The operation of only one batch plant was assumed for the Draft EIS. Plans to simultaneously operate two concrete batch plants during the facility construction period were identified based on updated design and construction planning information for the New Facility Alternative. In addition, expected material throughput increased. Air pollutant emissions and modeling are updated in Section 4.6 and Appendix E to address these project changes. Impact conclusions did not change for criteria or toxic air pollutants based on the updated modeling as discussed in Section 4.6. In addition, air quality modeling sensitivity analyses that were requested by the Idaho Department of Environmental Quality (IDEQ) in Appendix B of the Draft EIS were added to Appendix E. The sensitivity analyses showed that changes in the models did not result in changes to the air quality impact conclusions.

2.0 ALTERNATIVES

The Naval Nuclear Propulsion Program (NNPP) is proposing to recapitalize the naval spent nuclear fuel handling capabilities of the Expended Core Facility (ECF) at the Idaho National Laboratory (INL), as described in Section 1.2. In this Environmental Impact Statement (EIS), the NNPP considered the environmental impacts associated with three alternatives: (1) No Action, (2) Overhaul, and (3) New Facility. This section describes the three alternatives. Other alternatives considered but eliminated from further analysis are discussed in Section 2.2.

2.1 Alternatives for the Recapitalization of Naval Spent Nuclear Fuel Handling Capabilities

Consistent with programmatic decisions made by the United States (U.S.) Department of Energy (DOE) in ROD 1995, naval spent nuclear fuel would continue to be shipped by rail from shipyards and prototypes to INL for processing. To allow the NNPP to continue to unload, transfer, prepare, and package naval spent nuclear fuel for disposal, three alternatives were identified:

1. No Action Alternative – Maintain the naval spent nuclear fuel handling capabilities of the ECF by continuing to use the current ECF infrastructure while performing only preventative and corrective maintenance.

2. Overhaul Alternative – Recapitalize the naval spent nuclear fuel handling capabilities of ECF by overhauling ECF with major refurbishment projects for the ECF infrastructure and water pools to keep the infrastructure and water pools in safe working order and to provide the needed long-term capabilities for transferring, preparing, and packaging naval spent nuclear fuel.

3. New Facility Alternative – Recapitalize the naval spent nuclear fuel handling capabilities of ECF by constructing and operating a new facility at one of two potential locations at the Naval Reactors Facility (NRF).

Any alternative involving operation of a facility would involve eventual decontamination and decommissioning (D&D) of that facility. However, the timing of future D&D activities for a new facility or ECF is not known. Detailed impacts from D&D will be assessed at the end of the operations at ECF or the proposed new facility prior to the start of such activities. When the D&D plans are developed, they will require a separate environmental review and National Environmental Policy Act (NEPA) document. No meaningful alternatives or analysis of impacts can be formulated at this time since D&D will occur at an unknown time in the future. D&D is considered for cumulative impact analysis in Chapter 5.

2.1.1 No Action Alternative

The No Action Alternative involves maintaining ECF without a change to the present course of action or management of the facility. The current naval spent nuclear fuel handling infrastructure at ECF would continue to be used while performing only preventative and corrective maintenance. The No Action Alternative does not meet the purpose for the proposed action because it would not provide the infrastructure necessary to support the naval nuclear reactor defueling and refueling schedules required to meet the operational needs of the U.S. Navy. The No Action Alternative does not meet the NNPP's need because significant upgrades are necessary to the ECF infrastructure to continue safe and environmentally responsible naval spent nuclear fuel handling until at least 2060. As currently configured, the ECF infrastructure cannot support use of the new M-290 shipping containers. Significant changes in configuration of the facility and spent fuel handling processing locations in the water pool would be required to support unloading fuel from the new M-290 shipping containers. In addition, over the next 45 years, preventative and corrective maintenance without significant upgrades and refurbishments may not be sufficient to sustain the proper functioning of ECF infrastructure and equipment. Upgrades and refurbishments needed to support use of the new M-290 shipping containers and continue safe and environmentally responsible operations would not meet the definition of the No Action Alternative; therefore, these actions are represented by the Overhaul Alternative.

The implementation of the No Action Alternative (i.e., failure to perform upgrades and refurbishments), in combination with the NNPP commitment to only operate in a safe and environmentally responsible manner, may result in ECF eventually being unavailable for handling naval spent nuclear fuel. If the NNPP naval spent nuclear fuel handling infrastructure were to become unavailable, the inability to transfer, prepare, and package naval spent nuclear fuel could immediately and profoundly impact the NNPP's mission and national security needs to refuel and defuel nuclear-powered submarines and aircraft carriers. In addition, the NNPP could not ensure its ability to meet the requirements of the Idaho Settlement Agreement (SA 1995) and its 2008 Addendum (SAA 2008).

Since the No Action Alternative does not meet the purpose and need for the proposed action, it is considered to be an unreasonable alternative; however, the No Action Alternative is included in the EIS as required by Council on Environmental Quality regulations and is provided as a baseline for comparison to other alternatives.

2.1.2 Overhaul Alternative

The Overhaul Alternative involves continuing to use the aging infrastructure at ECF, while incurring additional costs to provide the required refurbishments and work-around actions necessary to ensure uninterrupted aircraft carrier and submarine refuelings and defuelings. Under the Overhaul Alternative, the NNPP would operate ECF in a safe and environmentally responsible manner by continuing to maintain ECF while implementing major refurbishment projects for the ECF infrastructure and water pools. This would entail:

- Short-term actions necessary to keep the infrastructure and equipment in safe working order including regular upkeep and actions sufficient to sustain their proper functioning (e.g., the ongoing work currently performed in the ECF to inspect and repair deteriorating water pool concrete coatings).

- Facility, process, and equipment reconfigurations needed for specific capabilities required in the future. These actions involve installation of new equipment and processes, and relocation of existing processes and equipment within the current facility to provide a new capability (e.g., modification of the ECF and reconfiguration of the water pool as necessary to handle M-290 shipping containers).

- Major refurbishment actions necessary to sustain the life of the infrastructure (e.g., to the extent practicable, overhaul the water pools to bring them up to current design and construction standards).

Failure to implement this overhaul in advance of infrastructure deterioration would impact the ability of ECF to operate. Further, overhaul actions would necessitate operational interruptions for extended periods of time.

The scope of the Overhaul Alternative is based on several factors: (1) the age of the ECF infrastructure; (2) acceptable service lifetimes for similar infrastructure; (3) major repair, refurbishment, and corrective maintenance needs; and (4) the time periods in which these actions would be needed. The overhaul actions needed to provide the required capabilities for the naval spent nuclear fuel handling infrastructure can be separated into two general categories: ECF infrastructure refurbishment (including ECF building structure, utilities, and service areas) and water pool refurbishment.

ECF infrastructure refurbishment would include correcting deteriorating conditions in the ECF building structure and supporting infrastructure due to the building's age. Parts of the building would be structurally reinforced, as necessary, and many supporting infrastructure systems would be replaced over time. These systems include the steam distribution system, pressurized air distribution system, and the potable water distribution system. As discussed in Section 4.11, a new security boundary system would be needed to improve the protection of the facility and other facilities on NRF.

Water pool refurbishment would include correcting deteriorating conditions. These overhaul actions would be necessary to ensure that the water pools support long-term use by, to the extent practicable, bringing the water pools up to current design and construction standards. Refurbishment efforts for the water pools could include actions such as lining the water pool to form a water-tight barrier between the water in the water pool and the concrete walls of the water pool, and reinforcing areas of known structural degradation. The water pools would need to be drained, decontaminated, and emptied of some equipment. This equipment would be discarded, due to the equipment exceeding its useful service life and the excessive cost to refurbish the equipment. As a result of the water pool overhaul, work-around actions would be required to ensure that ECF continued to support the mission-critical work of the naval nuclear-powered fleet.

New capabilities would be added to ECF during the overhaul. In 2016, the NNPP began to use the M-290 shipping container to transport naval spent nuclear fuel to NRF. To unload naval spent nuclear fuel from an M-290 shipping container into the water pool to examine, transfer, prepare, and package for disposal, the ECF water pools would need to be reconfigured to provide adequate footprint to allow installation of new equipment and processes. This reconfiguration would require additional disruption to the flow of work at ECF.

2.1.3 New Facility Alternative

Under the New Facility Alternative, the NNPP would acquire capital assets to recapitalize the naval spent nuclear fuel handling capabilities. While a new facility requires new process and infrastructure assets, the design could leverage use of the newer, existing ECF support facilities (Overpack Storage Building (OSB), Overpack Storage Expansions (OSEs), and the Cask Shipping and Receiving Facility (CSRF)) and would leverage use of newer equipment designs. The facility would also be designed with the flexibility to integrate future identified mission needs.

A new facility would include all current naval spent nuclear fuel handling operations conducted at ECF. In addition, it would include the capability to unload naval spent nuclear fuel from M-290 shipping containers in the water pool and to handle aircraft carrier spent nuclear fuel assemblies without prior disassembly for preparation and packaging for disposal. Such capability does not currently exist within the ECF water pools, mainly due to insufficient available footprint in areas of the water pool with the required depth of water. The New Facility Alternative would also include a new security boundary system to protect the new facility and other facilities on NRF from threats, as discussed in Section 4.11.

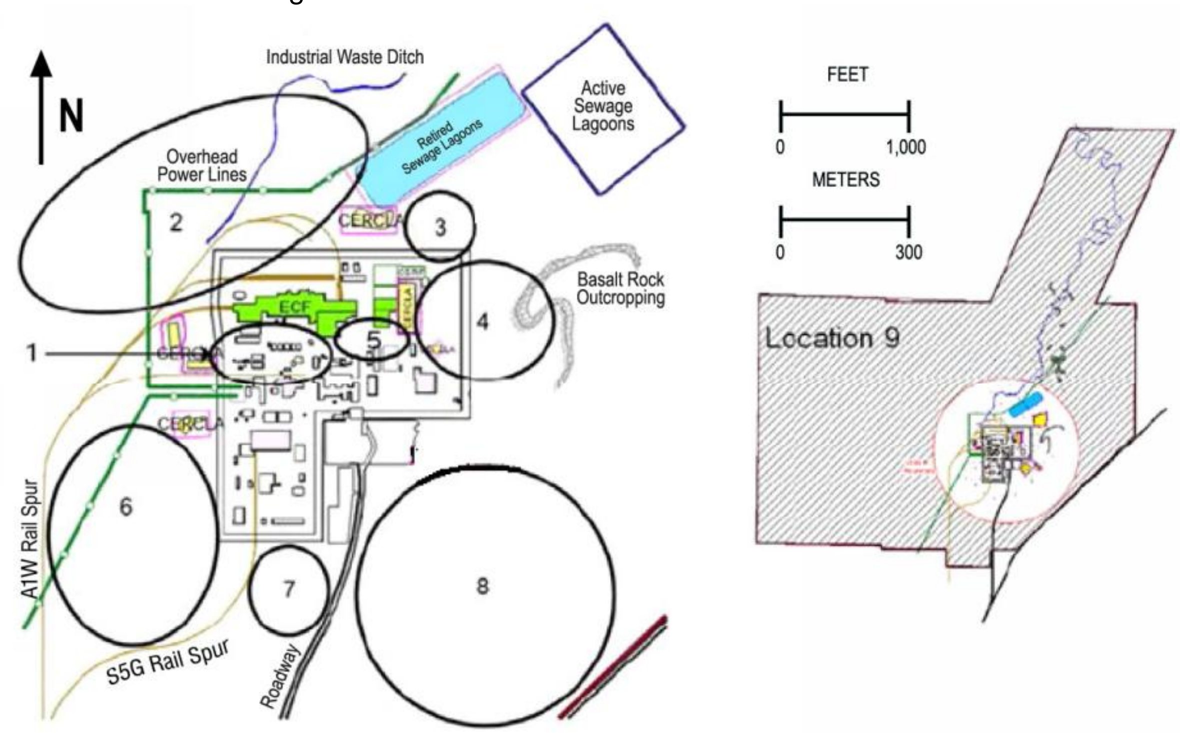
As described in Section 2.3, the NNPP would continue to operate ECF during new facility construction, during a transition period, and after the new facility is operational for examination work. To keep the ECF infrastructure in safe working order during these time periods, some limited upgrades and refurbishments may be necessary. Details are not currently available regarding which specific actions will be taken; therefore, they are not explicitly analyzed as part of the New Facility Alternative. However, the environmental impacts from these upgrades and refurbishments are considered to be bounded by the environmental impacts described for the Refurbishment Period of the Overhaul Alternative in Chapter 4.

Facility Locations

All of the sites being considered for construction of the New Facility Alternative are located on NRF property.

Originally, nine plausible locations were defined for a new facility at NRF (Figure 2.1-1). These locations were screened further, based on the defined needs of a new facility. The facility:

- Must have minimal impacts from a flood.
- Must not be located where construction or operation would prevent the handling and examination of naval spent nuclear fuel in existing facilities.
- Must not be located in an area that causes inefficient operations that would result in an inability to meet the required capacity for refueling or defueling of naval nuclear-powered ships.
- Must be within a radial distance around NRF of 945 meters (3100 feet) to remain within the maximum cost ceiling.



Note: Location 9 represents all of the areas outside a 945 meters (3100 feet) radius of ECF

Figure 2.1-1: Plausible Locations at NRF for a New Facility

Three of the nine locations (Locations 1, 5, 9) were eliminated due primarily to lack of available space and potential for impact on existing operations. Figure 2.1-2 shows the six potential locations that remained for further evaluation.

Some existing NRF naval spent nuclear fuel handling infrastructure could continue to be used following the construction of a new facility. The installation of supporting infrastructure is a critical element in the construction of a new facility. The design must account for the demolition, abandonment, and rerouting of existing utilities and support infrastructure to support the placement of a new facility. Construction site planning must account for rail line and roadway access to new and existing facilities during and post-construction. Each plausible site is unique with both desirable and undesirable elements that affect its suitability as a construction and operational facility site. Therefore, additional screening of the six potential remaining locations was performed based on the following criteria:

- Implement effective facility layout principles and provide flexibility for potential expansion of the facility to incorporate changing mission needs.
- Provide ample free space for a construction area and maximize ability to accommodate potential examination recapitalization plans, such as a new facility.
- Minimize the impact to historical, cultural, and Native American resources.
- Minimize infrastructure costs.
- Maximize use of existing facility assets.
- Minimize rock removal during construction to minimize costs.
- Avoid or minimize work in areas subject to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) controls and requirements to minimize environmental impact.
- Reduce the risk of delays during construction.
- Minimize conflicts with other NRF facilities and infrastructure (e.g., warehouses, monitoring wells, roads, and overhead power lines).

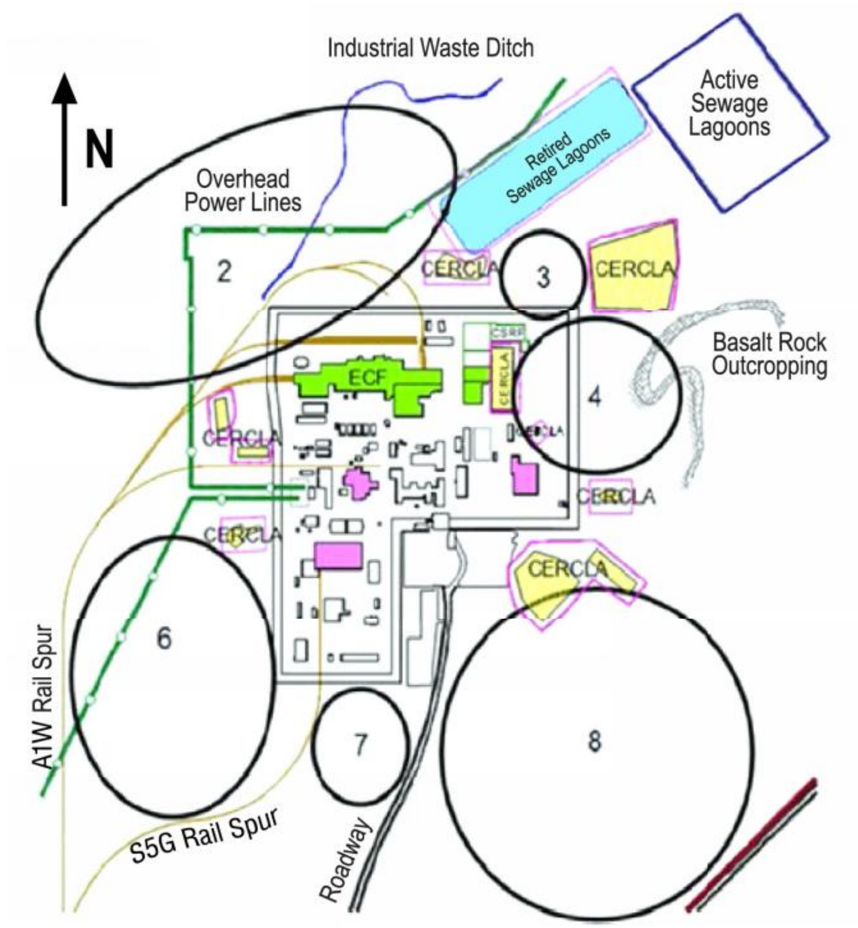


Figure 2.1-2: New Facility Locations Remaining After Initial Screening

During this evaluation, Location 3 and adjacent Location 4 were combined to take advantage of the lack of physical barrier between them; individually, each location had inadequate space for the project. This combined Location 3/4 and the four remaining locations were evaluated using the criteria described above. This analysis eliminated three additional locations (Locations 2, 7, and 8) leaving two alternative locations at NRF for further evaluation in this EIS: Location 3/4 and Location 6.

The borders of Location 3/4 are defined by the CSRF rail spur, existing NRF facilities, and CERCLA sites. Institutional controls determined to no longer be necessary have been removed for the CERCLA site located west of Location 3/4 (Section 3.3). Location 3/4 has the deepest soils of the locations screened. There are cultural resources located within the temporary disturbance area at Location 3/4 as described in Section 4.8.

Location 6 encompasses the area between the A1W rail spur, which connects to ECF; the southwest border of the NRF perimeter fence; and the S5G rail spur. Two monitoring wells and overhead power lines run diagonally through the northwest corner. A CERCLA site exists in the northeast corner of this location. However, institutional controls determined to no longer be necessary have been removed for this CERCLA site (Section 3.3). There are cultural resources located within the temporary disturbance area at Location 6 as described in Section 4.8.

Use of Existing Assets

Existing assets (the CSRF, the Spent Fuel Packaging Facility (SFPF), the OSB, and the OSEs (Figure 1.1-3)), were considered for use as part of the New Facility Alternative. Location 3/4 is in closer proximity to existing facilities providing a better interface with those facilities, which could minimize costs and reduce the risk to the schedule.

Conceptual Facility Description

At this time in project development, the design of the new facility is conceptual, and the facility design is subject to change until plans are final. However, the facility concept can be defined by key attributes.

- Naval spent nuclear fuel handling system attributes:
    - Water pool operations for naval spent nuclear fuel temporary wet storage, initial examinations, preparations for disposal, and loading of waste
    - Independent M-140 and M-290 shipping container receipt processes (receipt, preparation for unloading, unloading, maintenance, and shipping container return)
    - Dry operations for loading naval spent nuclear fuel canisters for temporary dry storage and disposal
    - Equipment and systems necessary to support production periods and optimal processing goals
    - Redundant systems to avoid a single point failure

- Facility attributes:
    - Incorporate infrastructure (e.g., rail tie-ins, roadways, utility connections) and integrate support facilities (e.g., offices, warehouses, training areas, mechanical and tool rooms)
    - Allow interface with or expansion into a potential facility for future examination recapitalization plans

The conceptual facility (Figure 2.1-3) would be made of steel with concrete footings and floors. The facility would have a footprint of approximately 23,200 square meters (250,000 square feet). The height of the facility would range from approximately 5 meters (16 feet) to 33 meters (107 feet); it would be comprised of the following specific purpose areas:

- M-290 shipping container unloading area
- M-140 shipping container unloading area
- Water pool processing area
- Waste handling area
- Naval spent nuclear fuel canister/overpack loading area
- Operational support area
- Warehouse
- Mechanical room/tool rooms
- Control points

The water pool processing area would contain water pools with a footprint of approximately 2900 square meters (30,000 square feet). The conceptual design of the water pool includes areas with depths that range between approximately 7.3 meters (24 feet) and 15 meters (50 feet). The water pools would contain approximately 550 ports to accommodate naval spent nuclear fuel from M-140 and M-290 shipping containers.

The water pools would be designed to be water-tight, and a leak test would be performed prior to start of operations. The design would facilitate the ability to detect and locate a leak. The water pool processing area water-tight barrier would be designed to facilitate the repair of leaks that may develop over its lifetime.

Conceptual Facility Layouts

The conceptual facility layout differs slightly between Location 3/4 and Location 6.

At Location 3/4 the OSB and OSEs would be used for concrete overpack fabrication and storage, and the CSRF would be used for loading M-290 shipping containers for shipments to an interim storage facility or a geologic repository (Figure 2.1-4). The layout of the new facility features two parallel pools, each with its own overhead crane runway. One pool is used to process naval spent nuclear fuel from M-290 shipping containers and the other is used to process naval spent nuclear fuel from M-140 shipping containers. The pools are connected with one transfer canal. Both of the shipping container unloading processes start on the south side where the rail cars enter the facility on parallel tracks and are processed to the north. Several cranes would be used to assist with unloading the shipping containers, water pool operations, and dry storage operations.

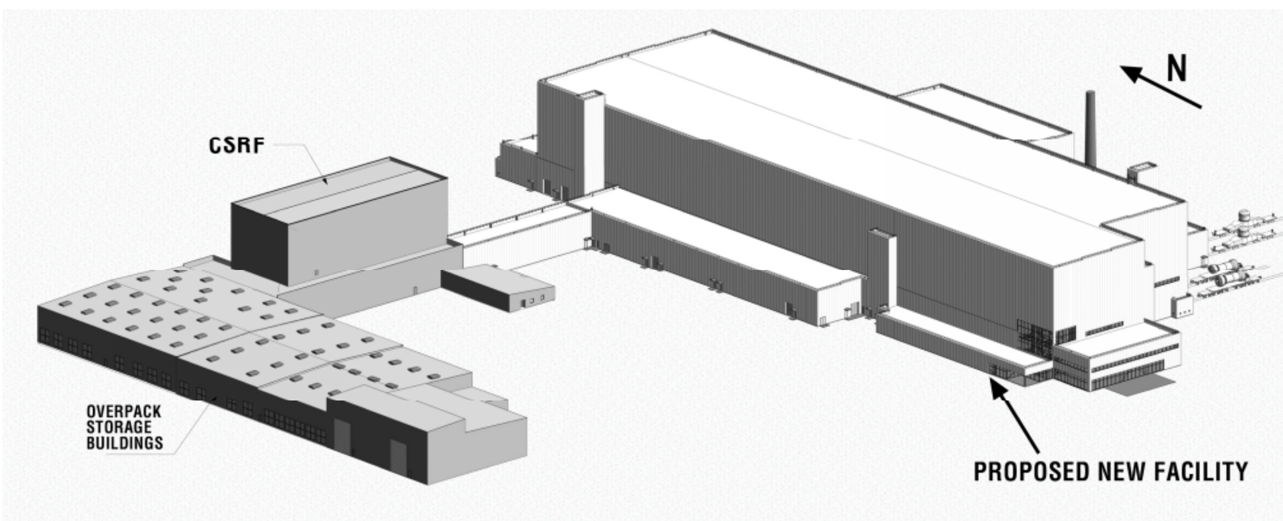


Figure 2.1-3: Conceptual New Facility at Location 3/4

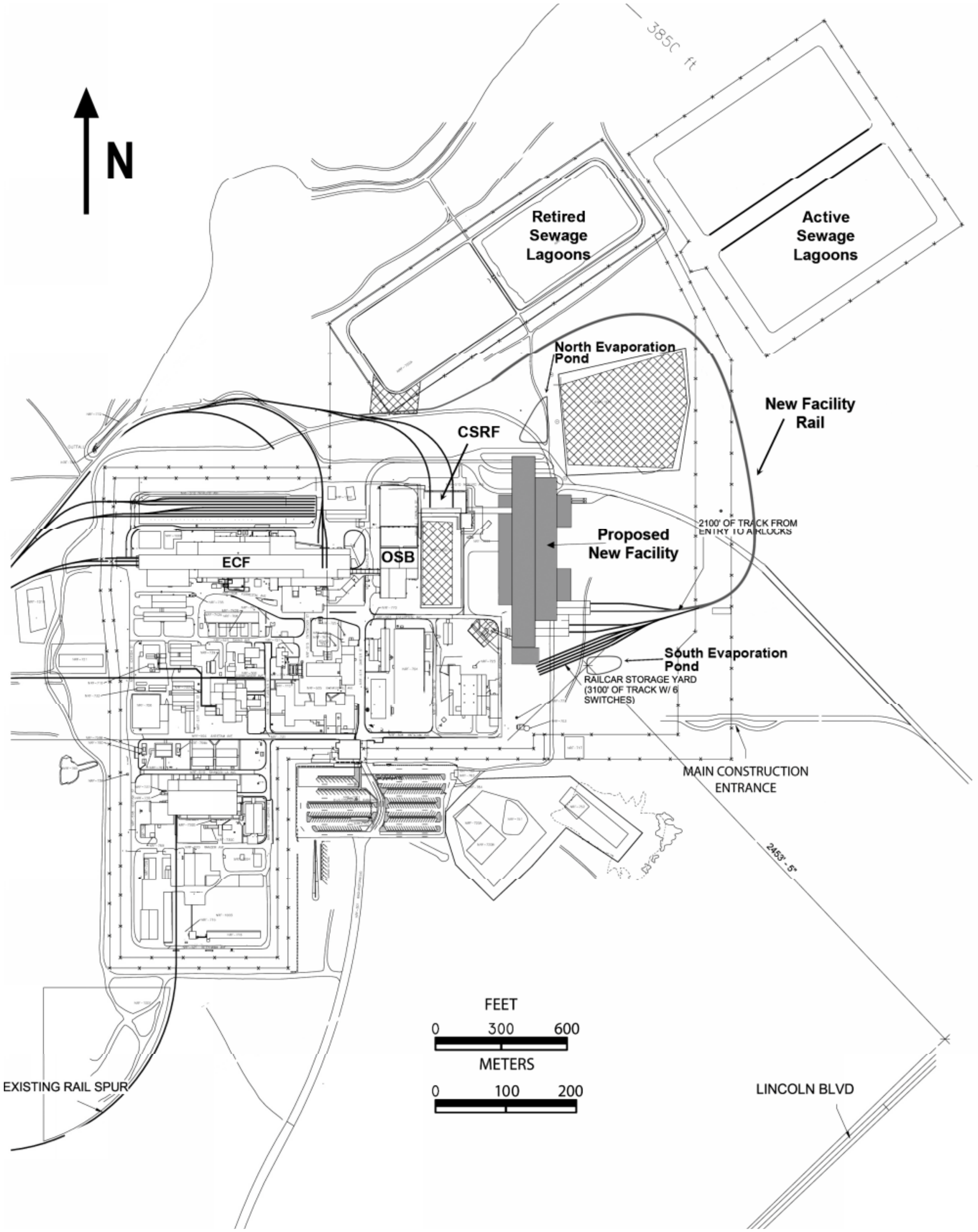


Figure 2.1-4: Conceptual New Facility Layout at Location 3/4

At Location 6 (Figure 2.1-5), the existing OSB, OSEs, and CSRF are too distant to allow for incorporation into the new facility. Therefore, all required naval spent nuclear fuel handling capabilities are included in the conceptual facility layout, including overpack fabrication, overpack storage, and loading of M-290 shipping containers for shipments to an interim storage facility or geologic repository. Two additional specific purpose areas would be needed for loading the M-290 shipping container and overpack storage, increasing the footprint by approximately 4650 square meters (50,000 square feet) compared to the footprint of the New Facility at Location 3/4.

A north-south orientation would allow the new facility to be located in the narrower northern section of Location 6, while maintaining space around the facility for rail spur and road access, as well as future expansion. Rail spur access would be provided for M-140 and M-290 shipping container unloading by connecting to the mainline coming into NRF. The shipping container loading area would be connected to the S5G rail spur from the south.

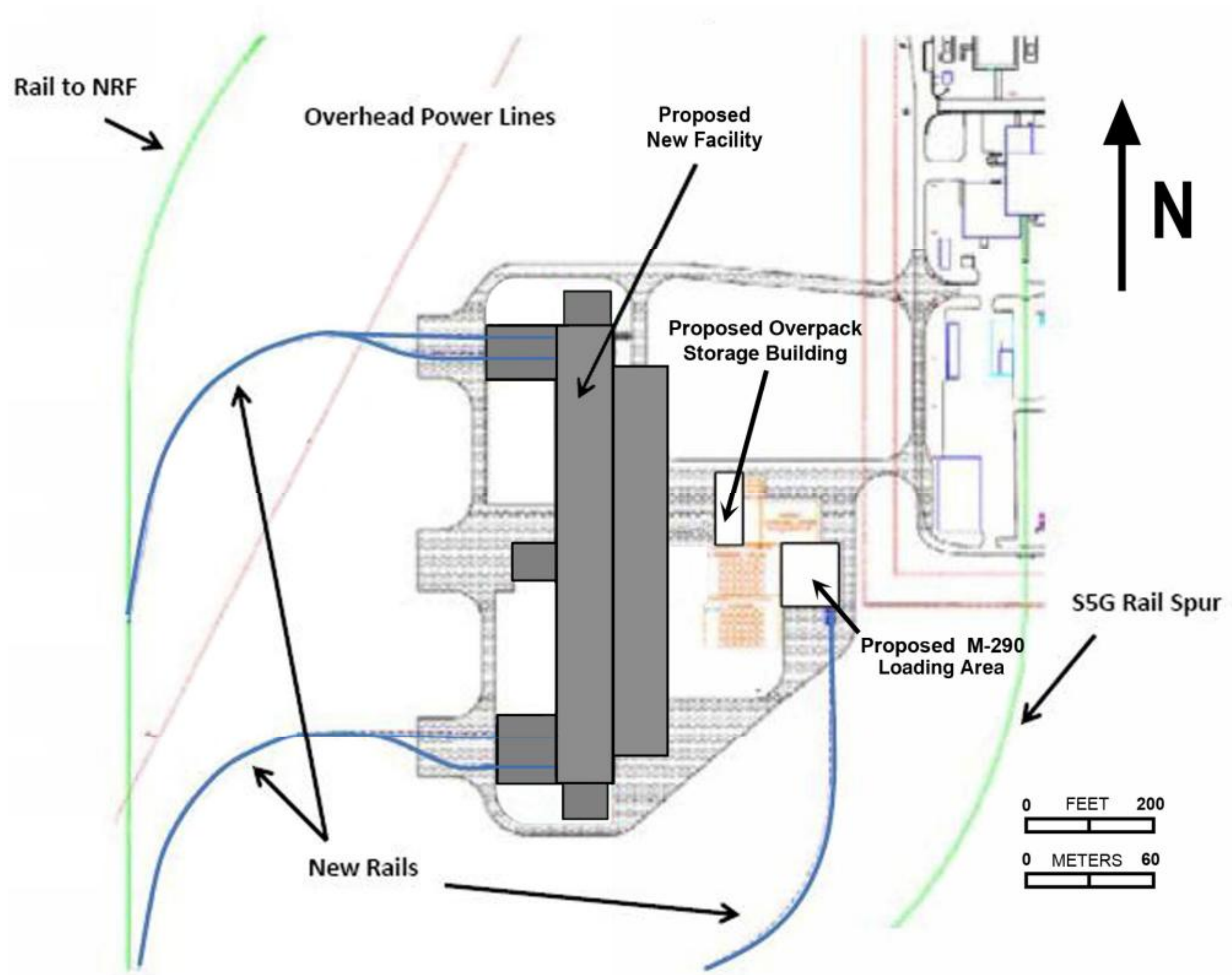


Figure 2.1-5: Conceptual New Facility Layout at Location 6

2.2 Alternatives Evaluated but Eliminated From Further Analysis

In addition to those alternatives identified, other siting locations for a new facility on the INL were evaluated. An alternate naval spent nuclear fuel handling process was also considered but eliminated from analysis. Further details are provided below.

Siting Locations

In accordance with DOE 1995, ROD 1995, ROD 1996, SA 1995, and SAA 2008, the NNPP would continue to handle (transfer, prepare, and package) and examine naval spent nuclear fuel at INL for the foreseeable future.

Potential sites on INL for new facilities were initially screened based on four criteria. The site:

- Must not be located near a fault where there has been ground movement at or near the ground surface at least once in the last 35,000 years or movement of a recurring nature within the past 500,000 years.
- Must be located where there would be minimal impacts from a flood.
- Must not be located in a wetland.
- Must not preclude reliable and cost-effective operations to transfer, prepare, examine, and package naval spent nuclear fuel to support fleet needs.

Figure 2.2-1 shows the areas on the INL which met these four criteria for the new facility. Two existing developed work areas at the INL were identified as candidate sites for a new facility (Idaho Nuclear Technology and Engineering Center (INTEC), and NRF) along with acceptable undeveloped areas at the INL (shown in green on Figure 2.2-1).

Although the initial screening did not eliminate the option of developing a new work area, it did reduce the amount of area within INL that is considered acceptable as a siting location to approximately 3 percent of the total INL land area.

Additional screening criteria were used to further evaluate the remaining sites and INL locations. These criteria included:

- Minimize radiation levels within the site boundary.
- Minimize radiation exposure to the public.
- Minimize the impact from earthquakes.
- Minimize the impact from flooding.
- Minimize the risk of releasing radioactive materials to the aquifer.
- Minimize the need for engineered safety provisions.
- Minimize the impact upon natural resources.
- Minimize the impact to historical, Native American, and cultural resources.
- Maximize accessibility to required services (emergency provisions, utilities, transportation).
- Maximize effective utilization of assets consistent with corporate planning.
- Minimize the difficulty in providing clear regulatory boundaries.
- Minimize the effort needed to protect NNPP classified information and nuclear materials.
- Minimize the risk of compromising state agreements.
- Minimize the risk of overrunning schedule.
- Minimize the risk of overrunning budget.
- Maximize supporting long-term operations.

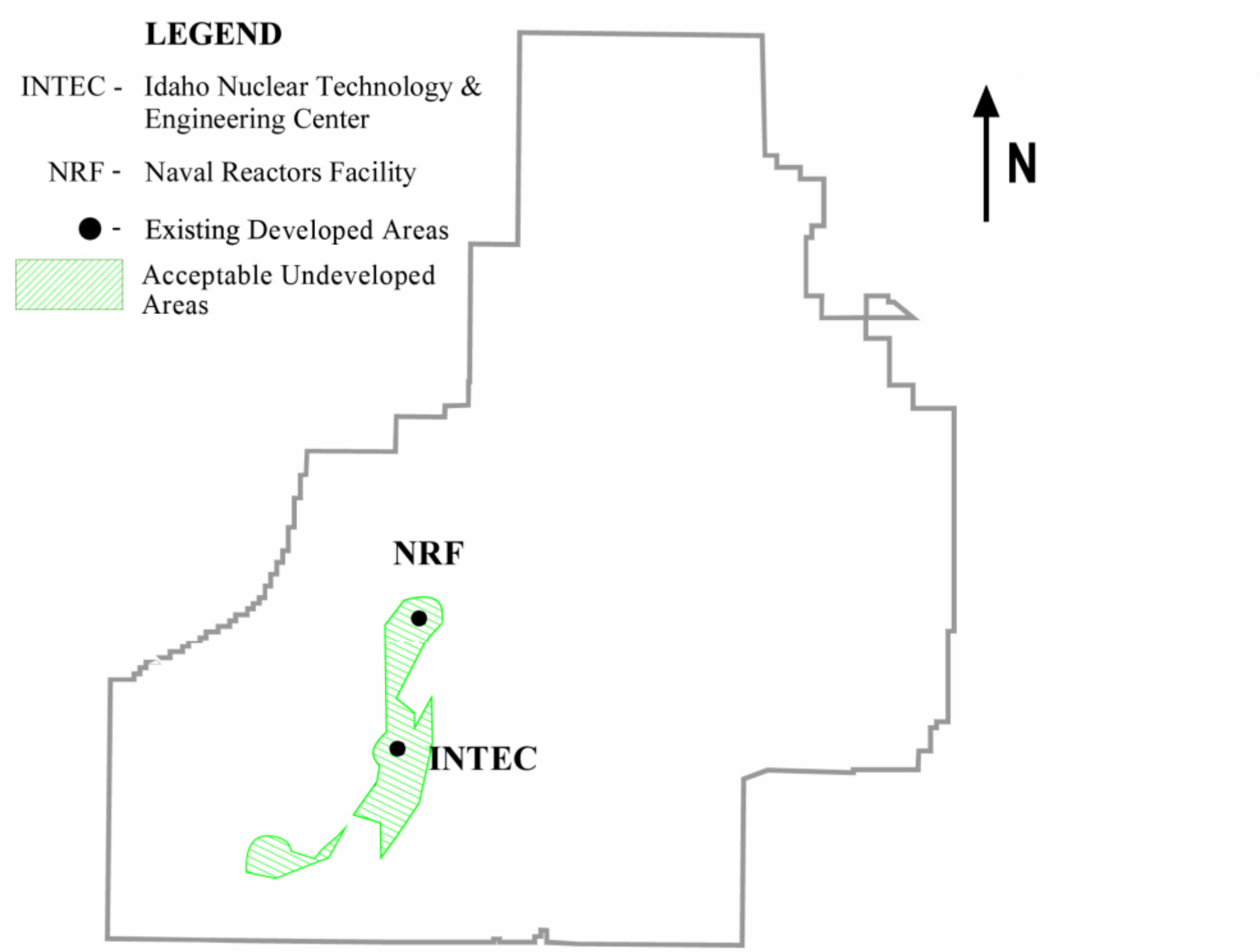


Figure 2.2-1: Acceptable Areas on INL for the New Facility Alternative

The following conclusions were reached from this evaluation:

- Recapitalizing by building new facilities at an existing INL work area would be more favorable than using existing radiological facilities. Stringent program standards controlling the spread of contamination and limiting radiation exposures to workers make refurbishment of existing radiological facilities less desirable.
- Recapitalizing by building new facilities at an existing INL work area would be more favorable than developing new facilities at a new INL work area, because use could be made of existing support infrastructure (e.g., existing roads; railway lines and sidings; utility systems; site maintenance facilities; office buildings; and cafeterias) reducing the environmental impacts compared to building new facilities at a new area. The high cost and environmental impact of including all support infrastructures eliminated new INL work area alternatives from further evaluation.
- INTEC would not offer any advantages over the other alternatives as a site for a new facility, since it: (1) has limited railway sidings, (2) is similar to NRF in distance to aquifer and flood plains, (3) would require additional transfer of radioactive material for examination and testing, and (4) has more significant historic levels of site contamination.

At the end of this evaluation, the preferred location on INL for a new facility was NRF.

Naval Spent Nuclear Fuel Handling Process Alternative

The new facility and overall process as evaluated would involve both water pool operation and dry operations. The overall process as evaluated would be similar to the existing, well-tested, naval spent nuclear fuel process currently used in ECF. The process as evaluated would utilize water pool operations for preliminary inspections, assembly processing, and loading of naval spent nuclear fuel canisters, and would utilize a dry process after loading the naval spent nuclear fuel canister.

Although minor changes to streamline the current naval spent nuclear fuel handling process in a new facility would be incorporated, the basic process would remain the same as for ECF. An alternative process for the new facility was considered and eliminated from further consideration. The alternative process would have been very different from the current process and shielding technology, involving mostly a dry environment, except for resizing naval spent nuclear fuel assemblies in a water pool. The alternative process would utilize High-Efficiency Particulate Air-ventilated shielded cells (thick concrete walls, floors, and ceiling (stainless steel-lined) with leaded glass viewing/operating gallery windows) for dry operations of naval spent nuclear fuel assembly storage and basket loading. Shielded transfer containers and transition shields would be the shielding technology for the dry operations of shipping container unloading and naval spent nuclear fuel canister loading. Combinations of containments, ventilation, transfer container features, and the use of water/moisture would be the radiological controls technology for these dry operations.

The alternative process offered the potential for a smaller water pool footprint and a shorter duration of naval spent nuclear fuel in a water pool for preparation operations. However, the alternative process had several significant design challenges (e.g., radiological concerns associated with maintenance of contaminated equipment located in a shielded cell) and involved technologies that have not yet been proven effective on the scale necessary for use on naval spent nuclear fuel. Although considered a potentially viable alternative, the alternate process was eliminated from further consideration because of the significant technical effort and cost associated with scaling the process to a production level.

2.3 Timeline and Duration

The following timeframes and durations were used when evaluating impacts related to the No Action Alternative, the Overhaul Alternative, and the New Facility Alternative.

No Action Alternative

The time period evaluated for the No Action Alternative is 45 years. The No Action Alternative descriptions in Chapter 4 provide a baseline against which impacts from the Overhaul Alternative and New Facility Alternative can be compared. The evaluations for the No Action Alternative cover: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

Overhaul Alternative

The time period evaluated for the Overhaul Alternative is 45 years.

Refurbishment Period

For the Overhaul Alternative, refurbishment activities would begin upon publication of the Record of Decision.

Chapter 4 addresses refurbishment activities for the Overhaul Alternative that would take place in parallel with ECF operations for the majority of the Overhaul Alternative time period. The first 33 years of the 45 years (i.e., the refurbishment period) would include refurbishment activities and operations in parallel. During certain refurbishment phases, operations could be limited due to the nature of the refurbishment activities (e.g., operations would not continue in water pools that are under repair). Although there would be fewer impacts at times over the 33-year refurbishment period from a reduction in operations, most of the evaluations in Chapter 4 do not consider these reductions and are therefore conservative.

Post-Refurbishment Operational Period

Chapter 4 addresses the 12 years where only operational activities would take place (i.e., post-refurbishment operational period) in ECF.

New Facility Alternative

The time period evaluated for the New Facility Alternative is 45 years.

Construction Period

Under the current budget and funding levels for the New Facility Alternative, it is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. Appendix E describes an exception to this assumption. Annual impacts reported based on being distributed over a 3-year construction period are conservative relative to impacts being distributed over a 5-year construction period. For example, with a longer than 3-year construction period, the total emissions or discharges would be expected to be spread over a longer period, thus decreasing impacts.

Construction of the New Facility Alternative will occur in parallel with ECF operations. The impacts from construction activities of the New Facility Alternative are presented in Chapter 4 in terms of increases to the baseline established in Chapter 3. The combined impacts of ECF operations and construction activities are also provided where the impact evaluation is capacity-dependent.

An approximate 2-year period would follow the construction of the New Facility Alternative when new equipment is installed, tested, and training is provided to qualify the operations workforce. This period of time is not explicitly analyzed and is bounded by the evaluation of impacts for the transition period for the New Facility Alternative described below.

Transition Period

Operations for the New Facility Alternative would overlap with current ECF operations. As described in Chapter 1, operations occur in ECF to support naval spent nuclear fuel examinations and naval spent nuclear fuel handling operations. For a period of time after the new facility is built, all ECF operations (exams and naval spent nuclear fuel handling) would continue. Eventually, the naval spent nuclear fuel handling operations would be fully transitioned from ECF to the new facility. The bounding time period when ECF continues full operations in parallel with new facility operations is explicitly evaluated in Chapter 4 as the transition period.

The timeframe of the transition period is dependent on several variables including the schedule of when naval spent nuclear fuel arrives from shipyards and prototypes and the rate of naval spent nuclear fuel handling operations in ECF. Current estimates show that the overlap in naval spent nuclear fuel handling operations in ECF and the new facility would last approximately 5 years. Earlier estimates have been as high as 12 years. The duration of the transition period does not impact the Chapter 4 evaluations because the impacts are provided on an annual basis.

<u>New Facility Operational Period</u>

Full operations for the New Facility Alternative would be expected to begin in the early 2020s. The facility, related structures, and support systems would be designed for a life of at least 40 years with normal maintenance, repair, and replacement. Therefore, operations for the New Facility Alternative would be expected to continue for at least 40 years.

Once all naval spent nuclear fuel handling operations transition from ECF into the new facility, ECF would continue to operate to support examinations. The duration of time that ECF would operate to support examinations is currently unknown and will be the subject of separate NEPA actions.

2.4 Baseline Operational Characteristics

Table 2.4-1 provides characteristics of current ECF operations derived from Chapter 3.

Table 2.4-1: Current Operational Characteristics

Resource/Material Category	Current Characteristics
Land Use	NRF is located in Butte County. The developed area of NRF consists of 34 hectares (84 acres).
Water Use	NRF average annual water use is approximately 140 million liters (37 million gallons). This is approximately 0.3 percent of the Federal Reserved Water Right for INL.
Non-Radiological Liquid Effluent	The NRF Industrial Waste Ditch (IWD) wastewater reuse permit requires certain non-radiological parameters to be monitored and stipulates the monitoring frequency. The monitoring data show no appreciable concentrations of heavy metals and varying levels of non-hazardous salts. The wastewater reuse permit has primary constituent standards for total nitrogen and total suspended solids. These standards were not exceeded in the IWD effluent based on 5 years of data. A permit is not required for the sewage lagoons; however, the retired sewage lagoons were monitored for the same parameters and on the same frequency as the IWD as a best management practice. The constituents released from NRF are not in concentrations that are harmful to the environment.
Radiological Liquid Effluent	NRF does not discharge radiological liquid effluent to the environment. NRF operates a water reuse system in association with the operation of ECF whereby liquids containing radioactivity are collected, processed, and reused rather than discharged to the environment. NRF monitors liquid effluent into the IWD and the active sewage lagoons for radiological parameters on a quarterly basis as a best management practice.
Non-Radiological Air Emissions	
Criteria Pollutants	The National Ambient Air Quality Standards set maximum levels of air pollutants in ambient air deemed to provide protection for human health and welfare. Limits have been established for six criteria pollutants: sulfur dioxide, nitrogen dioxide, particulate matter, carbon monoxide, lead, and ozone. INL as a whole, including NRF, is designated as “attainment,” “better than national standards,” or “unclassifiable/attainment,” depending on the criteria pollutant being considered. The modeling results for INL (including NRF) criteria pollutant concentrations for ambient air show that the standards are met for all pollutants and averaging times at INL and Craters of the Moon National Monument public receptor locations.

Table 2.4-1: Current Operational Characteristics (cont.)

Resource/Material Category	Current Characteristics
Greenhouse Gases (GHGs)	GHG emissions are reported as Scope 1, Scope 2, and Scope 3. Scope 1 are direct emissions from production of electricity, heat, cooling, or steam; mobile combustion sources (e.g., automobiles, ships, and aircraft); fugitive emissions within an agency's organizational boundary; and process emissions from laboratory activities. Scope 2 emissions are indirect or shared emissions associated with consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 3 emissions include all other indirect emissions not included in Scope 2 (e.g., business air/ground travel, employee commuting, contracted solid waste disposal, contracted wastewater treatment, subcontractor emissions, and transmission and distribution losses associated with purchased electricity). The NRF Fiscal Year (FY) 2012 inventory of GHGs totaled 15,400 metric tons (17,000 U.S. tons) of carbon dioxide equivalent (MT CO_2e). The total inventory is broken into Scope 1, Scope 2, and Scope 3 emissions. The NRF FY 2012 inventory of Scope 1 emissions was 4800 MT CO_2e (5300 U.S. tons). The NRF FY 2012 inventory of Scope 2 emissions was 8100 MT CO_2e (8900 U.S. tons). The NRF FY 2012 inventory of Scope 3 emissions was 2500 MT CO_2e (2800 U.S. tons).
Climate Change	INL and NRF are negligible contributors to GHG emissions on a state, and nationwide level and therefore negligible contributors to global climate change. The INL is located on the Eastern Snake River Plain which lies within the Great Basin Desert. The Great Basin Desert has warmed by 0.3 to 0.6 degrees Celsius (0.54 to 1.08 degrees Fahrenheit) in the last 100 years. Observed changes associated with global climate change within the Great Basin Desert include onset of early snowmelt, drought, and increase in wildfire frequency and intensity.
Visibility	The modeling results for INL (including NRF) indicate that visibility is not impaired by INL emissions since all visibility parameters are below threshold levels.
Prevention of Significant Deterioration (PSD)	The area surrounding INL is classified as Federal Class II, an area with reasonable or moderately good air quality while still allowing moderate industrial growth. Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park are classified as Federal Class I areas. PSD increments are established for Class I and Class II areas. Atmospheric dispersion modeling for PSD air pollutant concentrations at INL public receptor locations and Federal Class I areas done cumulatively for all INL facilities (including NRF) shows that all pollutants are within the increases allowed under the PSD program and do not contribute to a deterioration in air quality.

Table 2.4-1: Current Operational Characteristics (cont.)

Resource/Material Category	Current Characteristics
Toxic Air Pollutants	Atmospheric dispersion modeling for toxic air pollutant concentrations at INL public receptor locations done cumulatively for all INL facilities (including NRF) shows that Idaho Administrative Procedures Act standards are met for all pollutants and averaging times, indicating concentrations do not injure or unreasonably affect human or animal life or vegetation.
Radiological Air Emissions	The majority of the radiological air emissions at NRF are from activities at ECF such as unloading naval spent nuclear fuel from shipping containers, loading naval spent nuclear fuel canisters for temporary dry storage, water pools where naval spent nuclear fuel is processed and stored, and shielded cells where test specimen and naval spent nuclear fuel examinations are performed. In 2009, NRF radiological air emissions were approximately 0.95 Curies. In 2009, NRF operations accounted for approximately 0.02 percent of the total radiological air emissions from INL.
Noise	Noise at NRF is not transmitted at detectable levels off-site since the closest site boundary is 10.5 kilometers (6.5 miles) from the center point at NRF and the closest member of the public (a residence that is occupied year round) is located 13.7 kilometers (8.5 miles) from NRF.
Workforce	Approximately 1370 people work at NRF.
Electricity Use	The peak electrical demand at NRF is approximately 6 megawatts.
Fuel Use	NRF uses fuel oil for its three fuel oil-fired boilers. Fuel oil usage at NRF is approximately 2,280,000 liters (603,000 gallons) annually. NRF uses approximately 42,000 liters (11,000 gallons) per year of diesel fuel for emergency diesel generators and miscellaneous combustion sources. NRF uses approximately 5300 liters per year (1400 gallons per year) of gasoline on miscellaneous combustion sources.

Table 2.4-1: Current Operational Characteristics (cont.)

Resource/Material Category	Current Characteristics
Occupational Radiation Exposure	The average exposure per person monitored since 1979 is about 0.0006 Sievert (0.06 rem) per year for NRF personnel. This dose is approximately one-sixth the average annual exposure to a member of the population in the U.S. from natural background radiation, less than one-fourth the average annual exposure to a member of the population in the U.S. from common diagnostic medical x-ray procedures, and less than the difference in the annual exposure due to natural background radiation between Denver, Colorado, and Washington, D.C. Decreases in annual radiation exposure have been achieved as a result of continuing efforts to reduce radiation exposures to the minimum practicable. 2010 exposure data for individuals involved in naval spent nuclear fuel handling operations shows the highest average annual exposure of 0.00018 Sievert (0.018 rem) was obtained by technicians who unload shipping containers. These exposures are even lower than the running average for which perspective is provided above.
Public Radiation Exposures	Specific provisions of the Environmental Protection Agency (EPA) National Emissions Standards for Hazardous Air Pollutants standards (40 C.F.R. § 61, Subpart H) limit the radionuclide dose to a member of the public to 10 millirem per year. The annual dose limit applies to the maximally exposed off-site individual and is designed to protect public health with an adequate margin of safety. The radiation dose to the Maximally Exposed Off-site Individual (MOI), living at the INL property boundary, from NRF and ECF routine operation releases for 2009 was approximately 2.7×10^{-9} Sievert (2.7×10^{-7} rem). The radiation dose to the surrounding population from NRF and ECF routine operation releases for 2009 was approximately 9.0×10^{-5} Sievert (9.0×10^{-3} rem). The individual doses from NRF are well below the 10 millirem per year limit.
Waste Generation and Shipments	
High-Level Radioactive Waste	NRF does not currently generate any high-level radioactive waste.
Transuranic Waste	NRF does not currently generate any transuranic waste from naval spent nuclear fuel handling operations.

Table 2.4-1: Current Operational Characteristics (cont.)

Resource/Material Category	Current Characteristics
Solid Low-Level Radioactive Waste (LLW)	Operations at ECF result in generation of solid LLW primarily consisting of filters, resin, contaminated components, pieces of insulation, rags, sheet plastic, paper, and filter paper and towels resulting from radiochemistry and radiation monitoring operations. The annual average of LLW waste generated at NRF is 740 cubic meters (960 cubic yards) from routine activities and 1200 cubic meters (1600 cubic yards) from D&D activities. There are 38 shipments of LLW from NRF annually.
Toxic Substances Control Act (TSCA) Waste	TSCA waste at NRF includes waste containing polychlorinated biphenyls (PCBs). The annual average of TSCA waste generated at NRF is 1.6 metric tons (1.8 U.S. tons). The annual average of low-level radioactive TSCA waste generated at NRF is 10.3 metric tons (11.4 U.S. tons). There are 12 shipments of low-level radioactive TSCA waste from NRF annually. Non-radioactive TSCA waste is included with the 12 annual shipments of hazardous waste described below.
Mixed Low-Level Radioactive Waste (MLLW) and TSCA MLLW	NRF generates a small amount of MLLW and TSCA MLLW, primarily from D&D activities at ECF. The annual average of MLLW and TSCA MLLW generated at NRF is 20 cubic meters (26 cubic yards). There are 12 shipments of MLLW (including TSCA MLLW) from NRF annually.
Resource Conservation and Recovery Act (RCRA) Hazardous Waste	The annual average of RCRA hazardous waste generated at NRF is 1.4 metric tons (3.0 cubic meters) from routine activities and 1.5 metric tons (2.6 cubic meters) from D&D activities. The weight to volume conversions are impacted by shipping frequencies and container sizes. There are 12 shipments of RCRA hazardous waste (which include non-radioactive TSCA waste, as applicable) from NRF annually.

Table 2.4-1: Current Operational Characteristics (cont.)

Resource/Material Category	Current Characteristics
Non-Hazardous Waste	At NRF, non-hazardous waste generally consists of routine waste generated by personnel on-site. As much as possible, recyclable materials are segregated from the solid waste stream in accordance with waste minimization and pollution prevention protocols. The annual average of non-hazardous solid waste generated at NRF is 4600 cubic meters (6000 cubic yards) from routine activities and 2500 cubic meters (3300 cubic yards) from D&D activities. There are 52 shipments of non-hazardous waste from NRF annually.

2.5 Basis for Analysis

Chapter 4 of this EIS presents an evaluation of the environmental impacts of the alternatives. Unless otherwise noted, there would be no changes to the existing naval spent nuclear fuel handling processes used in ECF associated with the proposed action.

Refurbishment activities and new facility design are conceptual in nature. Therefore, they are not described in detail in this EIS. However, for the purpose of environmental impact analysis, conservative assumptions are used. Thus, the impacts from the implementation of the proposed action would likely be less than those analyzed in this EIS.

Estimates associated with the number of personnel at NRF affect many resource evaluations in Chapter 4. In most cases, the change in number of naval spent nuclear fuel handling workers due to the proposed action is used in impact evaluations. However, the total change in the number of NRF personnel during the time periods evaluated for each alternative is provided for use in system capacity impact evaluations (e.g., in Section 4.4). Although these labor estimates are described in Section 4.10, they are repeated here to aid in the comparison of impacts provided in Section 2.6.

Employment impacts are estimated by evaluating both the direct and indirect impacts. Direct impacts are jobs and income that result directly from the proposed action (e.g., creation of a construction job). Indirect impacts are jobs and income created in the community as a result of the direct impacts created by the proposed action.

- While ECF operations continue under the No Action Alternative, employment would be expected to remain at current levels. Although operations activities in the ECF would be reduced, these reductions would be offset by increased maintenance activities. If operations cease under the No Action Alternative, employment would decrease.
- For the refurbishment period of the Overhaul Alternative, impacts associated with an additional 180 refurbishment workers and 220 indirect jobs in the Region of Influence (ROI) are evaluated. There would be no change to the number of naval spent nuclear fuel handling workers during the refurbishment period. With the exception of the increase in employment from the 180 construction jobs, NRF employment levels would be expected to remain at current levels during the 33-year refurbishment period.
- For the post-refurbishment period of the Overhaul Alternative, impacts associated with an additional 80 naval spent nuclear fuel handling workers and 140 indirect jobs in the ROI are evaluated. These additional naval spent nuclear fuel handling workers would be necessary to

perform work delayed during the refurbishment period. Also, NRF employment unrelated to the proposed action is projected to decrease during this period. Therefore, the total increase in NRF employment during the post-refurbishment operational period would be approximately 50 workers.

- For the construction period of the New Facility Alternative, impacts associated with an additional 360 direct construction jobs and 450 indirect jobs in the ROI are evaluated. Also, NRF employment unrelated to the proposed action is projected to increase during this period. Therefore, the total increase in NRF employment during the construction period would be approximately 420 workers.
- For the transition period of the New Facility Alternative, impacts associated with an additional 60 naval spent nuclear fuel handling workers and 110 indirect jobs in the ROI are evaluated. The additional naval spent nuclear fuel handling workers would be necessary due to parallel operations in ECF and the new facility. Also, NRF employment unrelated to the proposed action is projected to decrease during the transition period. Therefore, the total increase in NRF employment during this time-period would be approximately 45 workers.
- For the new facility operational period, impacts associated with 60 fewer naval spent nuclear fuel handling workers and 100 indirect jobs in the ROI are evaluated. The decrease in number of naval spent nuclear fuel handling workers reflects the efficiency gains in the new facility. Also, NRF employment that is unrelated to the proposed action is projected to decrease during this time-period. Therefore, the total decrease in NRF employment for the operational period would be approximately 110 workers.

2.6 Comparison of Alternatives

This section provides a comparison of environmental impacts and costs associated with the alternatives evaluated in this EIS. Table 2.6-1 compares the environmental impacts of the alternatives, summarizing the evaluations provided in Chapter 4 for each resource area. Section 2.6.1 summarizes the reasons for the differences between environmental impacts of the alternatives provided in Table 2.6-1. Additional detail on the impact evaluation for each time period of each alternative is provided in Chapter 4. As demonstrated in Chapter 4, there are very few differences in impacts between a new facility at Location 3/4 and a new facility at Location 6. Therefore, Table 2.6-1 and Section 2.6.1 only discuss the locations where relevant.

With the following exceptions, there are no environmental impacts associated with any of the alternatives, or the impacts are negligible or small:

- For the No Action Alternative, there would be large and profound impacts to naval spent nuclear fuel management and national security needs.
    - While ECF operations continue, management of M-290 shipping containers and work stoppages would affect fleet performance and the ability to manage naval spent nuclear fuel in accordance with SA 1995 and SAA 2008.
    - If ECF operations cease, the NNPP would eventually be unable to defuel and refuel submarines, leading to the inability of the nuclear-powered ships or their nuclear-trained naval personnel to be deployed or redeployed into fleet operations. Additionally, the NNPP would be unable to meet the requirements of SA 1995 and SAA 2008.
- For the refurbishment period of the Overhaul Alternative, there would be moderate impacts on naval spent nuclear fuel management from temporary work stoppages; however, the facility would be operated to minimize the impact on the NNPP’s ability to meet its mission.

- For the New Facility Alternative, there would be beneficial impacts on naval spent nuclear fuel management once the new facility is fully operational because of increased process efficiencies.
- For the No Action Alternative, the refurbishment period of the Overhaul Alternative, and the construction and transition period of the New Facility Alternative, the impact from seismic hazards to ECF, without additional refurbishment or upgrades, would be moderate from the continued degradation of the facility over time.
- For the New Facility Alternative, electrical energy consumption impacts would be moderate in the transition period and the new facility operational period.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Land Use Impacts			
Land Use	There would be no impact on land use since no land would be disturbed.	Refurbishment Period: There would be small impacts on land use from the disturbance of approximately 20 hectares (50 acres) of which 2 hectares (4 acres) would remain developed for the new security boundary system. Post-Refurbishment Operational Period: There would be no impact on land use since no land would be disturbed.	Construction Period: There would be small impacts on land use from land disturbance of up to 60 hectares (150 acres) of which 16 hectares (40 acres) would remain permanently developed for facilities and infrastructure. Transition Period: There would be no impact on land use since no land would be disturbed. New Facility Operational Period: There would be no impact on land use since no land would be disturbed.
Transportation Impacts			
Naval Spent Nuclear Fuel Shipments	There would be negligible impacts from shipments of naval spent nuclear fuel since shipments are infrequent.		
Infrastructure	There would be no impact on transportation infrastructure since no transportation infrastructure would be added.	Refurbishment Period: There would be no impact on transportation infrastructure since no transportation infrastructure would be added. Post-Refurbishment Operational Period: There would be no impact on transportation infrastructure since no transportation infrastructure would be added.	Construction Period: There would be small impacts on transportation infrastructure from the addition of temporary gravel roadways, paved roadways, and additional rail line. Transition Period: There would be no impact on transportation infrastructure since no transportation infrastructure would be added.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Transportation Impacts (cont.)			
Infrastructure (cont.)			New Facility Operational Period: There would be no impact on transportation infrastructure since no transportation infrastructure would be added.
Personnel	While ECF operations continue, there would be no impact from personnel transportation since the average daily traffic would not increase. If ECF operations cease, the average daily traffic could decrease.	Refurbishment Period: There would be small impacts from an average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately 3 percent. Post-Refurbishment Operational Period: There would be a negligible impact from an average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately 0.3 percent.	Construction Period: There would be small impacts from an average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately 6 percent. Transition Period: There would be a negligible impact from an average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately 0.3 percent. New Facility Operational Period: There would be negligible beneficial impacts from an average decrease in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately 0.3 percent.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Transportation Impacts (cont.)			
Material Shipments	There would be no impact from transportation of materials since the number of shipments would be expected to remain within the current range.	Refurbishment Period: There would be a negligible impact on transportation from approximately one additional shipment of materials each day. Post-Refurbishment Operational Period: There would be no impact on transportation from material shipments since the number of shipments would be expected to remain within the current range.	Construction Period: There would be small impacts to transportation from approximately 50 additional shipments per day resulting in an increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 of approximately less than 1 percent. Transition Period: There would be no impact on transportation from material shipments since the number of shipments would be expected to remain within the current range. New Facility Operational Period: There would be no impact on transportation from material shipments since the number of shipments would be expected to remain within the current range.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Transportation Impacts (cont.)			
Non-Hazardous Waste, RCRA Hazardous Waste (including non-radioactive TSCA waste), and Recyclable Material Shipments	While ECF operations continue, there would be no impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material since the same number of shipments would be required. If ECF operations cease, there could be a decrease in the number of shipments.	Refurbishment Period: There would be no impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material. The volume of waste in each shipment would increase, but would not exceed the capacity of the routine shipment. Post-Refurbishment Operational Period: There would be no impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material. The volume of non-hazardous waste and recyclable material in the shipment would increase, but would not exceed the capacity of the routine shipment. The volume of RCRA hazardous waste would not increase.	Construction Period: There would be a negligible impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material. For the RCRA hazardous and recyclable material shipments, the volume of waste or materials in each shipment would increase but would not exceed the capacity of the routine shipment. There would be approximately one additional shipment per day of non-hazardous solid waste. Transition Period: There would be no impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material. The volume of non-hazardous waste and recyclable material would increase but would not exceed the capacity of the routine shipment. The volume of RCRA hazardous waste would not increase.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Transportation Impacts (cont.)			
Non-Hazardous Waste, RCRA Hazardous Waste (including non-radioactive TSCA waste), and Recyclable Material Shipments (cont.)			New Facility Operational Period: There would be no impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material. The volume of non-hazardous waste and recyclable material would decrease. The volume of RCRA hazardous waste would not increase.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Transportation Impacts (cont.)			
Radiological Waste Shipments	While ECF operations continue, there would be no impact from transportation of radiological waste since the same number of shipments would be required. If ECF operations cease, there could be a decrease in the number of shipments.	Refurbishment Period: There would be no impact from transportation of radioactive TSCA waste and MLLW. The volume of radioactive TSCA waste and MLLW in each shipment would increase, but would not exceed the capacity of the routine shipments. There would be a negligible impact from transportation of approximately one additional shipment of solid LLW each day. Post-Refurbishment Operational Period: There would be no impact from transportation of radioactive TSCA waste and MLLW, since radioactive TSCA waste and MLLW generation would not increase. There would be no impact from transportation of approximately six additional solid LLW shipments per year.	Construction Period: There would be no impact from transportation of radiological waste since radiological waste would not be generated. Transition Period: There would be no impact from transportation of radioactive TSCA waste and MLLW since radioactive TSCA waste and MLLW would not be generated. There would be no impact from transportation of approximately eight additional solid LLW shipments per year. New Facility Operational Period: There would be no impact from transportation of radioactive TSCA waste and MLLW since radioactive TSCA waste and MLLW would not be generated. There would be no impact from transportation of approximately eight additional solid LLW shipments per year.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Geological and Soil Impacts			
Use of Geologic and Soil Resources	There would be no impact on geologic and soil resources since no geologic or soil resources would be consumed or excavated.	<u>Refurbishment Period</u>: There would be small impacts to geologic and soil resources from the use of approximately 13,000 cubic meters (17,000 cubic yards) and the excavation of approximately 16,000 cubic meters (21,000 cubic yards). <u>Post-Refurbishment Operational Period</u>: There would be no impact on geologic and soil resources since no geologic or soil resources would be consumed or excavated.	<u>Construction Period:</u> There would be small impacts to geologic and soil resources from the use of approximately 160,000 cubic meters (209,000 cubic yards) and the excavation of approximately 406,000 cubic meters (531,000 cubic yards), for Location 3/4. There would be small impacts to geologic and soil resources from the use of approximately 179,000 cubic meters (235,000 cubic yards) and excavation of approximately 578,000 cubic meters (756,000 cubic yards), for Location 6. <u>Transition Period</u>: There would be no impact on geologic and soil resources since no geologic or soil resources would be consumed or excavated. <u>New Facility Operational Period</u>: There would be no impact on geologic and soil resources since no geologic or soil resources would be consumed or excavated.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Geological and Soil Impacts (cont.)			
Quality of Geologic and Soil Resources	There would be no impact to the quality of geologic and soil resources since no geologic or soil resources would be consumed or excavated.	Refurbishment Period: There would be small impacts to the quality of geologic and soil resources from compaction of soil; diminished topsoil quality and quantity resulting from stockpiling and erosion; erosion and sedimentation resulting from changes to the terrain; slight changes to topography resulting from grading and backfilling; and the creation of temporary, unstable slopes. Post-Refurbishment Operational Period: There would be no impact to the quality of geologic and soil resources since no geologic or soil resources would be consumed or excavated.	Construction Period: There would be small impacts to the quality of geologic and soil resources from compaction of soil; diminished topsoil quality and quantity resulting from stockpiling and erosion; erosion and sedimentation resulting from changes to the terrain; slight changes to topography resulting from grading and backfilling; and the creation of temporary, unstable slopes. Transition Period: There would be no impact to the quality of geologic and soil resources since no geologic or soil resources would be consumed or excavated. New Facility Operational Period: There would be no impact to the quality of geologic and soil resources since no geologic or soil resources would be consumed or excavated.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Geological and Soil Impacts (cont.)			
Soil Contamination	There would be small impacts from radiological constituents in the soil if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak. There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills.	<u>Refurbishment Period</u>: There would be small impacts from radiological constituents in the soil if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak. There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills. <u>Post-Refurbishment Operational Period</u>: There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills.	<u>Construction Period:</u> There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills. <u>Transition Period</u>: There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills. <u>New Facility Operational Period</u>: There would be no impact due to the use of best management practices for controlling contamination from chemical or petroleum leaks or spills.
Volcanic Hazards	Based on the low probability of occurrence for volcanic hazards, the potential impacts would be negligible.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Geological and Soil Impacts (cont.)			
Seismic Hazards	There would be moderate impacts from seismic hazards, without additional refurbishment or upgrades, from the continued degradation of the existing facility over time.	Refurbishment Period: There would be moderate impacts from seismic hazards until refurbishment activities are complete. Activities during the refurbishment period would improve the building's ability to withstand vibratory ground motions from seismic activity. Post-Refurbishment Operational Period: There would be small impacts from seismic hazards since the refurbishment actions would improve the building's ability to withstand vibratory ground motions from seismic activity.	Construction Period: There would be small impacts from seismic hazards, without additional refurbishment or upgrades, from the continued degradation of the existing facility over a short period of time. Transition Period: There would be moderate impacts from seismic hazards, without additional refurbishment or upgrades, from the continued degradation of the existing facility over time. There would be small impacts from seismic hazards for the new facility since SSCs would be designed to withstand vibratory ground motions from seismic activity. New Facility Operational Period: There would be moderate impacts from seismic hazards, without additional refurbishment or upgrades, from the continued degradation of the existing facility over time. There would be small impacts from seismic hazards for the new facility since SSCs would be designed to withstand vibratory ground motions from seismic activity.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts			
Radiological Effluent	There would be no impact from radiological effluent since none would be discharged to surface water or the Snake River Plain Aquifer (SRPA).		
Big Lost River	There would be no impact since wastewater or storm water would not be discharged to the Big Lost River.		
Process Wastewater Constituents	While ECF operations continue, there would be no impact to water quality from discharge of process wastewater since no new constituents are expected in process wastewater discharges; constituent concentrations would not change. If ECF operations cease, constituent concentrations could decrease.	Refurbishment Period: There would be no impact to water quality from discharge of process wastewater since no new constituents are expected in process wastewater discharges; constituent concentrations would not change. Post-Refurbishment Operational Period: There would be no impact to water quality from discharge of process wastewater since no new constituents are expected in process wastewater discharges; constituent concentrations would not change.	Construction Period: There would be no impact to water quality from discharge of process wastewater since no new constituents are expected in process wastewater discharges; constituent concentrations would not change. Transition Period: There could be small impacts to water quality from an increase in the total output of non-hazardous salts in process wastewater discharge. New Facility Operational Period: There could be small impacts to water quality from an increase in the total output of non-hazardous salts in process wastewater discharge.
Storm Water Constituents	There would be no impact to water quality from discharge of storm water since no new constituents are expected in storm water discharges; constituent concentrations would not change.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
Process Wastewater and Storm Water Discharge Volumes	While ECF operations continue, there would be no impact from discharge to the IWD since discharge volumes would not change. If ECF operations cease, process wastewater discharge volumes could decrease.	<u>Refurbishment Period:</u> There would be no impact from discharge to the IWD since discharge volumes would not change. <u>Post-Refurbishment Operational Period:</u> There would be no impact from discharge to the IWD since discharge volumes would not change.	<u>Construction Period</u>: There could be an increase in discharge volume to the IWD of approximately 44 percent from potential discharges associated with water pool leak testing; however, there would be no impact because total NRF discharge to the IWD would be within approximately 55 percent of the IWD permit limit. There would be a small impact to the amount of water seeping into the perched water zone at the outfall of the IWD due to the potential increased volume of water discharge. <u>Transition Period</u>: There would be an increase in discharge volume to the IWD of approximately 0.6 percent from process wastewater discharges at Location 3/4 and 35 percent from process wastewater and storm water discharges at Location 6. There would be no impact because total NRF discharge to the IWD would be within approximately 38 percent (Location 3/4) and 52 percent (Location 6) of IWD permit limit.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
Process Wastewater and Storm Water Discharge Volumes (cont.)			Transition Period (cont.): There would be a small impact to the amount of water seeping into the perched water zone at the outfall of the IWD due to increased volume of water discharge. New Facility Operational Period: There would be an increase in discharge volume to the IWD of approximately 0.6 percent from process wastewater discharges at Location 3/4 and 35 percent from process wastewater and storm water discharges at Location 6. There would be no impact because total NRF discharge to the IWD would be within approximately 38 percent (Location 3/4) and 52 percent (Location 6) of IWD permit limit. There would be a small impact to the amount of water seeping into the perched water zone at the outfall of the IWD due to increased volume of water discharge.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
IWD Erosion and Sedimentation	While ECF operations continue, there would be no impact from discharge to the IWD since discharge volumes would not change. If ECF operations cease, there could be a decrease in discharge volume.	Refurbishment Period: There would be no impact since there is no increase in discharge volumes to the IWD. Post-Refurbishment Operational Period: There would be no impact since there is no increase in discharge volumes to the IWD.	Construction Period: There could be small impacts from potential discharges associated with the water pool leak testing. Transition Period: There would be no impact from increased discharge volumes due to best management practices. New Facility Operational Period: There would be no impact from increased discharge volumes due to best management practices.
Sanitary Wastewater Constituents	There would be no impact to water quality from discharge of sanitary wastewater since no new constituents are expected in sanitary wastewater discharges; constituent concentrations would not change.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
Discharge Volume to the Active Sewage Lagoons	While ECF operations continue, there would be no impact from discharge to the active sewage lagoons since discharge volumes would not change. If ECF operations cease, the discharge volume to the active sewage lagoons could decrease.	Refurbishment Period: There would be no impact from the increase in annual and daily discharge to the active sewage lagoons of approximately 13 percent. The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons. Post-Refurbishment Operational Period: There would be no impact from the increase in annual and daily discharge to the active sewage lagoons of approximately 4 percent. The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons.	Construction Period: There would be no impact from potential discharge to the active sewage lagoons since the potential for discharge of water from leak testing the water pools would be within the design operating parameters of the active sewage lagoons. Transition Period: There would be no impact from the increase in annual and daily discharge to the active sewage lagoons of approximately 2 percent. The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons. New Facility Operational Period: There would be no impact from the decrease in annual and daily discharge to the active sewage lagoons.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
Groundwater	There would be no impact to groundwater from non-radiological constituents since best management practices would continue to be used to protect groundwater. There would be negligible impacts on groundwater from radiological constituents if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak.	Refurbishment Period: There would be no impact to groundwater from non-radiological constituents since best management practices would continue to be used to protect groundwater. There would be negligible impacts on groundwater from radiological constituents if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak prior to water pool refurbishment. Post-Refurbishment Operational Period: There would be no impact to groundwater since best management practices would continue to be used to protect groundwater.	Construction Period: There would be no impact to groundwater since best management practices would continue to be used to protect groundwater. Transition Period: Best management practices will continue to be used to protect groundwater. However, there could be small impacts to groundwater from potential increases in non-hazardous salts in wastewater discharges. New Facility Operational Period: Best management practices will continue to be used to protect groundwater. However, there could be small impacts to groundwater from potential increases in non-hazardous salts in wastewater discharges.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Quality Impacts (cont.)			
Drinking Water	There would be negligible impacts on drinking water sources if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak.	Refurbishment Period: There would be negligible impacts on drinking water sources if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak prior to water pool refurbishment. Post-Refurbishment Operational Period: There would be no impact to drinking water since wellhead protection measures would continue to be used.	Construction Period: There would be no impact to drinking water since wellhead protection measures would continue to be used. Transition Period: There would be no impact to drinking water since wellhead protection measures would continue to be used. New Facility Operational Period: There would be no impact to drinking water since wellhead protection measures would continue to be used.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Water Use Impacts			
Surface Water Use	There would be no impact from use of surface water since all water is obtained from the SRPA.		
Groundwater Use	While ECF operations continue, there would be no impact to the SRPA from groundwater use since volume of water use would not change. If ECF operations cease, there could be a decrease in groundwater use.	<u>Refurbishment Period</u>: There would be a negligible impact to the SRPA from the increase in groundwater use of approximately 5 percent because NRF groundwater use would only be approximately 0.4 percent of the Federal Reserved Water Right for INL. <u>Post-Refurbishment Operational Period</u>: There would be a negligible impact to the SRPA from the increase in groundwater use of approximately 2 percent because NRF groundwater use would only be approximately 0.4 percent of the Federal Reserved Water Right for INL.	<u>Construction Period</u>: There would be a negligible impact to the SRPA from the increase in groundwater use of approximately 50 percent because NRF groundwater use would only be approximately 0.6 percent of the Federal Reserved Water Right for INL. <u>Transition Period</u>: There would be a negligible impact to the SRPA from the increase in groundwater use of approximately 9 percent because NRF groundwater use would only be approximately 0.4 percent of the Federal Reserved Water Right for INL. <u>New Facility Operational Period</u>: There would be a negligible impact to the SRPA from the increase in groundwater use. The increase would be from non-potable water use.
Vegetation Impacts			
Federal/State-Listed Species	There would be no impact to federal-listed or state-listed plant species, or designated critical habitat, since none occurs on NRF property or on INL. There would be no impact to rare or sensitive plant species since there are none at NRF.		
Non-Radiological Air Pollutant Emissions	There would be no impact on vegetation from non-radiological air pollutant emissions since all air pollutant standards would be met.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Vegetation Impacts (cont.)			
Radiological Dose Assessment from Routine Naval Spent Nuclear Fuel Handling Operations	There would be no impact on vegetation from radiological releases during routine naval spent nuclear fuel handling operations because the radionuclide concentrations would be well below biota concentration guides.		
Radiological Dose Assessment from Hypothetical Accidents	There would be small impacts to vegetation from radiological releases in the event of a hypothetical accident. Mitigation plans for biota would be considered based on the level and extent of contamination in accordance with the graded approach established in DOE 2002e.		
Loss or Disturbance of Vegetation	There would be no impact from loss or disturbance of vegetation since there would be no land disturbance.	<u>Refurbishment Period:</u> There would be small impacts from removal of vegetation from approximately 13 hectares (33 acres) for construction of a new security boundary system. <u>Post-Refurbishment Operational Period:</u> There would be no impact from loss or disturbance of vegetation because there would be no land disturbance.	<u>Construction Period:</u> There would be small impacts from removal of vegetation; however, the impacted plant communities are well represented across INL. Approximately 55 hectares (136 acres) of land, much of which has been previously disturbed and is dominated by non-native species, would be cleared of vegetation at Location 3/4. Land disturbance at Location 6 would be smaller. There would be small impacts to vegetation from soil erosion and sedimentation due to increased storm water runoff. <u>Transition Period:</u> There would be no impact from loss of vegetation because there would be no land disturbance. There would be small impacts to vegetation from soil erosion and sedimentation due to increased storm water runoff.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Vegetation Impacts (cont.)			
Loss or Disturbance of Vegetation (cont.)			<u>New Facility Operational Period:</u> There would be no impact from loss of vegetation because there would be no land disturbance. There would be small impacts to vegetation from soil erosion and sedimentation due to increased storm water runoff.
Noxious Weeds and Non-Native Species	There would be no impact from noxious weeds and non-native species since there will be no land disturbance.	<u>Refurbishment Period:</u> There would be small impacts from the potential establishment of non-native species and noxious weeds in cleared areas for the new security boundary system. The spread of noxious weeds and non-native plants would continue to be minimized by best management practices. <u>Post-refurbishment Operational Period:</u> There would be no impact from noxious or non-native species since there would be no land disturbance.	<u>Construction Period:</u> There would be small impacts from the potential establishment of non-native species and noxious weeds in cleared areas for construction. The spread of noxious weeds and non-native plants would continue to be minimized by best management practices. <u>Transition Period:</u> There would be no impact from noxious weeds or non-native species since there would be no land disturbance. <u>New Facility Operational Period:</u> There would be no impact from noxious weeds or non-native species since there would be no land disturbance.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Wildlife Impacts			
Federal/State-Listed Species	There would be no impact to federal-listed or state-listed threatened or endangered wildlife or designated critical habitat since none occur on the NRF property.		
Non-Radiological Air Pollutant Emissions	There would be no impact on wildlife from exposure to contaminants since all air pollutant standards would be met and no changes in concentrations of arsenic, lead, or mercury (identified as ecological risk drivers) would occur in the IWD or active sewage lagoons.		
Radiological Dose Assessment from Routine Naval Spent Nuclear Fuel Handling Operations	There would be no impact on wildlife from radiological releases during routine naval spent nuclear fuel handling operations because the radionuclide concentrations would be well below biota concentration guides.		
Radiological Dose Assessment from Hypothetical Accidents	There would be small impacts to wildlife from radiological releases in the event of a hypothetical accident. Mitigation plans for biota would be considered based on the level and extent of contamination in accordance with the graded approach established in DOE 2002e.		
Habitat Loss and Fragmentation	There would be no impact from habitat loss or fragmentation since there would be no land disturbance.	<u>Refurbishment Period:</u> There would be small impacts due to habitat loss from ground disturbance. There would also be small impacts from habitat loss and fragmentation from the new security boundary system. <u>Post- Refurbishment Operational Period:</u> There would be small impacts due to habitat loss and fragmentation from the new security boundary system.	<u>Construction Period:</u> There would be small impacts due to habitat loss and fragmentation from ground disturbance. There would also be small impacts from habitat loss and fragmentation from the new security boundary system. <u>Transition Period:</u> There would be small impacts due to habitat loss and fragmentation from permanent facility structures and the new security boundary system. <u>New Facility Operational Period:</u> There would be small impacts due to habitat loss and fragmentation from permanent facility structures and the new security boundary system.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Wildlife Impacts (cont.)			
Localized Death or Injury	While ECF operations continue, there would be no impact from localized death and injury since there would be no changes in activity levels. If ECF operations cease, there could be a decrease in localized death and injury due to a decrease in activity levels.	Refurbishment Period: There would be small impacts from localized death and injury from land clearing and construction activities associated with the new security boundary system for small animals. Large animals would avoid the area. Post-Refurbishment Operational Period: There would be no impact from localized death and injury since there would be no additional land clearing or construction activities.	Construction Period: There would be small impacts from localized death and injury from land clearing and construction activities for small animals. Large animals would avoid the area. Transition Period: There would be no impact from localized death and injury since there would be no additional land clearing or construction activities. New Facility Operational Period: There would be no impact from localized death and injury since there would be no additional land clearing or construction activities.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Wildlife Impacts (cont.)			
Noise	While ECF operations continue, there would be no impact to wildlife from noise since there would be no change in noise levels. If ECF operations cease, noise levels could decrease.	<u>Refurbishment Period:</u> There would be small impacts to wildlife from area avoidance due to increased noise levels during construction of the new vehicle boundary system. <u>Post-Refurbishment Operational Period:</u> There would be no impact to wildlife from noise because there would be no change in noise levels.	<u>Construction Period:</u> There would be small impacts to wildlife from area avoidance due to increased noise levels during construction of the new facility. <u>Transition Period:</u> There would be small impacts to wildlife from noise because impacts from area avoidance would be extended over a greater area (combined habitat around ECF and a new facility). <u>New Facility Operational Period:</u> There would be small impacts to wildlife from noise because impacts from area avoidance would be extended over a greater area (combined habitat around ECF and a new facility).

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Non-Radiological Air Quality Impacts			
Criteria, Toxic, and PSD Air Pollutant Emissions	There would be no impact from emissions of criteria, toxic, and PSD air pollutants since there would be no change in pollutant emissions.	Refurbishment Period: There would be a negligible impact from emissions of criteria air pollutants from an increase in workforce traffic. Intermittent fugitive dust and equipment emissions from the construction of the new security boundary system would have a negligible impact on pollutant concentrations at receptor locations. There would be no impact from operations in ECF since there would be no change in criteria, toxic, or PSD pollutant emissions. Post-Refurbishment Operational Period: There would be a negligible impact from an increase in traffic emissions. There would be no impact from operations in ECF since there would be no change in criteria, toxic, or PSD pollutant emissions.	Construction Period: There would be small impacts from an increase in criteria and PSD air pollutant emissions and negligible impacts from an increase in toxic air pollutant emissions. However, all air quality standards would be met for criteria, toxic, and PSD air pollutants at INL receptor locations. PSD standards would be met for Federal Class I areas. Transition Period: There would be negligible impacts from an increase in criteria, toxic, and PSD air pollutant emissions. All air quality standards would be met for criteria, toxic, and PSD air pollutants at INL receptor locations. PSD standards would be met for Federal Class I areas. New Facility Operational Period: There would be negligible impacts from an increase in criteria, toxic, and PSD air pollutant emissions. All air quality standards would be met for criteria, toxic, and PSD air pollutants at INL receptor locations. PSD standards would be met for Federal Class I areas.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Non-Radiological Air Quality Impacts (cont.)			
Visibility, Ozone, and Deposition	There would be no impact to visibility, ozone, or deposition at Federal Class I areas since there would be no changes to pollutant emissions.	Refurbishment Period: There would be no impact to visibility, ozone, or deposition at Federal Class I areas since there would be no changes to pollutant emissions. Post-Refurbishment Operational Period: There would be no impact to visibility, ozone, or deposition at Federal Class I areas since there would be no changes to pollutant emissions.	Construction Period: There would be small impacts to visibility, ozone, or deposition at Federal Class I areas since air pollutant emissions would increase. However, all threshold values would be met. Transition Period: There would be negligible impacts to visibility, ozone, or deposition at Federal Class I areas since air pollutant emissions would increase. However, all threshold values would be met. New Facility Operational Period: There would be negligible impacts to visibility, ozone, or deposition at Federal Class I areas since air pollutant emissions would increase. However, all threshold values would be met.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Non-Radiological Air Quality Impacts (cont.)			
Greenhouse Gases (GHGs)	There would be no impact from GHG emissions since there would be no change in pollutant emissions.	<u>Refurbishment Period:</u> There would be negligible impacts from small increases in GHG emissions primarily associated with increased commuting and increased purchased electricity. <u>Post-Refurbishment Operational Period:</u> There would be negligible impacts from small increases in GHG emissions primarily associated with increased commuting.	<u>Construction Period:</u> There would be negligible impacts from small increases in GHG emissions primarily associated with increased commuting and on-site operation of construction equipment. Diesel generators and purchased electricity would also contribute to GHG emissions. <u>Transition Period:</u> There would be negligible impacts from small increases in GHG emissions primarily associated with purchased electricity and fuel oil-fired boilers. <u>New Facility Operational Period:</u> There would be negligible impacts from small increases in GHG emissions primarily associated with purchased electricity and fuel oil-fired boilers.
Climate Change	There would be small impacts from continued climate change that could pose threats to infrastructure and risk to worker health and safety through increased frequency and severity of extreme weather events (e.g., drought, thunderstorms, strong winds, hail, tornadoes, snow storms, dust devils, and wildfires). There is also potential for persistent drought to increase risk of power disruptions during summer months, when water shortages could lead to decreased energy production from the region's electricity facilities. Increased temperatures resulting in additional cooling demands in the summer may also impact the proposed action by contributing to power disruption or by increasing stress on cooling systems. These potential vulnerabilities can be mitigated through existing NRF safety, operations, and emergency planning processes.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Radiological Air Quality Impacts			
Radiological Pollutant Emissions	While ECF operations continue, there would be no impact from radiological emissions since radiological emissions could decrease. If ECF operations cease, there would be a decrease in radiological emissions.	<u>Refurbishment Period:</u> There would be no impact from radiological emissions since radiological emissions would not change. <u>Post-Refurbishment Operational Period:</u> There would be a negligible impact from radiological pollutant emissions since the total NRF radiological emissions would represent less than 0.03 percent of INL emissions.	<u>Construction Period:</u> There would be no impact from radiological emissions since construction would not involve any radioactive materials or produce any radiological emissions. <u>Transition Period:</u> There would be a negligible impact from radiological pollutant emissions since the total NRF radiological emissions would represent less than 0.03 percent of INL emissions. <u>New Facility Operational Period:</u> There would be a negligible impact from radiological pollutant emissions since the total NRF radiological emissions would represent less than 0.03 percent of INL emissions.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Noise Impacts			
Noise Levels	While ECF operations continue, there would be no impact to public and sensitive receptors since noise levels would not change. If ECF operations cease, there could be a decrease in noise levels.	<u>Refurbishment Period</u>: There would be no impact to public and sensitive receptors from refurbishment activity noise levels due to the distance of public receptors. There would be negligible impacts to public and sensitive receptors located along U.S. Highway 20, U.S. Highway 26, and State Route 33 from an increase in traffic noise. <u>Post-Refurbishment Operational Period</u>: There would be no impact to public and sensitive receptors since noise levels would not change.	<u>Construction Period</u>: There would be no impact to public and sensitive receptors from construction activity noise levels due to the distance of the public receptors. There would be negligible impacts to public and sensitive receptors located along U.S. Highway 20, U.S. Highway 26, and State Route 33 from an increase in traffic noise. <u>Transition Period:</u> There would be no impact to public and sensitive receptors since noise levels would not change. <u>New Facility Operational Period</u>: There would be no impact to public and sensitive receptors since noise levels would not change.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Cultural Resource Impacts			
Cultural Resources and Historic Properties	There would be no impact to cultural resources or historic properties since there would be no ground disturbance, visual changes, or culturally or historically significant changes made to ECF.	<u>Refurbishment Period:</u> There would be no impact to cultural resources since there are no cultural resources or historic properties located in the disturbance area. <u>Post-Refurbishment Operational Period:</u> There would be no impact to cultural resources since no land would be disturbed.	<u>Construction Period:</u> There would be small unavoidable impacts to Native American cultural resources; however, no resources eligible for listing on the National Register of Historic Places would be disturbed at Location 3/4 or Location 6. <u>Transition Period</u>: There would be no impact to cultural resources since no land would be disturbed. <u>New Facility Operational Period</u>: There would be no impact to cultural resources since no land would be disturbed.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Visual/Scenic Resource Impacts			
Landscape Contrast	There would be no impact to visual/scenic resources from landscape contrast since no new structures would be built.	Refurbishment Period: There would be no impact to visual/scenic resources from landscape contrast since the new security boundary system would be at ground level and would not be visible from surrounding areas. Post-Refurbishment Operational Period: There would be no impact to visual/scenic resources from landscape contrast since no new structures would be built.	Construction Period: There would be no impact to visual/scenic resources from landscape contrast since the new facility would be consistent with the current visual character of NRF. Transition Period: There would be no impact to visual/scenic resources from landscape contrast since no new structures would be built. New Facility Operational Period: There would be no impact to visual/scenic resources from landscape contrast since no new structures would be built.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Visual/Scenic Resource Impacts (cont.)			
Deterioration of Landscape	There would be no impact to visual/scenic resources from deterioration of the landscape since emissions would not cause an increase in visibility impacts.		Construction Period: There would be a small impact to visual/scenic resources from deterioration of the landscape since emissions would cause a small increase in visibility impacts. Transition Period: There would be a negligible impact to visual/scenic resources from deterioration of the landscape since emissions would cause a negligible increase in visibility impacts. New Facility Operational Period: There would be a negligible impact to visual/scenic resources from deterioration of the landscape since emissions would cause a negligible increase in visibility impacts.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Socioeconomic Impacts			
Employment	While ECF operations continue, there would be no impact to employment since employment levels at NRF would not change. If ECF operations cease, there would be small impacts to levels of employment from a decrease in the number of workers.	Refurbishment Period: There would be a small beneficial impact from an increase of 180 direct refurbishment jobs. Post-Refurbishment Operational Period: There would be a small beneficial impact from an increase of 80 naval spent nuclear fuel handling jobs.	Construction Period: There would be a small beneficial impact from an increase of 360 direct construction jobs. Transition Period: There would be a small beneficial impact from an increase of 60 naval spent nuclear fuel handling jobs. New Facility Operational Period: There would be a small impact from the reduction of 60 naval spent nuclear fuel handling jobs.
Region of Influence (ROI) Population Increase	While ECF operations continue, there would be no impact to ROI population since employment levels at NRF would not change. If ECF operations cease, there could be a negligible impact from a population decrease in the ROI.	Refurbishment Period: There would be a negligible impact from a population increase of less than 0.01 percent in the ROI. Post-Refurbishment Operational Period: There would be a negligible impact from a population increase of approximately 0.04 percent in the ROI.	Construction Period: There would be a negligible impact from a population increase of approximately 0.01 percent in the ROI. Transition Period: There would be a negligible impact from a population increase of approximately 0.03 percent in the ROI. New Facility Operational Period: There would be a negligible impact from a population decrease of approximately 0.03 percent in the ROI.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Socioeconomic Impacts (cont.)			
Housing Vacancies	While ECF operations continue, there would be no impact to housing vacancies since employment levels at NRF would not change. If ECF operations cease, there could be a negligible impact from an increase in housing vacancies.	<u>Refurbishment Period</u>: There would be a negligible impact from a decrease in housing vacancies of approximately 0.06 percent in the ROI. <u>Post-Refurbishment Operational Period</u>: There would be a negligible impact from a decrease in housing vacancies of approximately 0.7 percent in the ROI.	<u>Construction Period</u>: There would be a negligible impact from a decrease in housing vacancies of approximately 0.1 percent in the ROI. <u>Transition Period</u>: There would be a negligible impact from a decrease in housing vacancies of approximately 0.5 percent in the ROI. <u>New Facility Operational Period</u>: There would be a negligible impact from an increase in housing vacancies of approximately 0.5 percent in the ROI.
Taxes	While ECF operations continue, there would be no impact to local and state revenues since employment levels at NRF would not change. If ECF operations cease, there could be a small annual impact from a decrease in local and state revenues.	<u>Refurbishment Period</u>: There would be a small annual beneficial impact from an increase in local and state revenues of approximately $6 million. <u>Post-Refurbishment Operational Period</u>: There would be a small annual beneficial impact from an increase in local and state revenues of approximately $3 million.	<u>Construction Period</u>: There would be a small annual beneficial impact from an increase in local and state revenues of approximately $9 million. <u>Transition Period</u>: There would be a small annual beneficial impact from an increase in local and state revenues of approximately $2 million. <u>New Facility Operational Period</u>: There would be a small annual impact from a decrease in local and state revenues of approximately $2 million.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Socioeconomic Impacts (cont.)			
Public Service Levels	While ECF operations continue, there would be no impact to public service levels since employment levels at NRF would not change. If ECF operations cease, there would be no impact to public service levels since no less teachers, police officers or firefighters would be required to maintain current levels of service.	<u>Refurbishment Period</u>: There would be a negligible impact to public service levels since less than one additional teacher, firefighter, and police officer would be required to maintain current levels of service. <u>Post-Refurbishment Operational Period</u>: There would be small impacts to public service levels since two additional teachers, and less than one additional firefighter and police officer would be required to maintain current levels of service.	<u>Construction Period</u>: There would be a negligible impact to public service levels since less than one additional teacher, firefighter, and police officer would be required to maintain current levels of service. <u>Transition Period</u>: There would be small impacts to public service levels since two additional teachers, and less than one additional firefighter and police officer would be required to maintain current levels of service. <u>New Facility Operational Period</u>: There would be no impact to public service levels since two fewer teachers and no additional police officers or firefighters would be required to maintain current levels of service.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Energy Consumption, Site Utilities, and Security Infrastructure Impacts			
Energy Consumption	There would be no impact from energy consumption since there would not be an increase in energy demand.	Refurbishment Period: There would be small impacts from energy consumption due to an increase in peak electrical demand of 0.5 megawatts (approximately 10 percent over current NRF electrical demands), and a small increase in consumption of diesel fuel and gasoline. Post-Refurbishment Operational Period: There would be beneficial impacts to energy consumption from the incorporation of Federal High Performance and Sustainable Building Guiding Principles.	Construction Period: There would be small impacts from energy consumption due to an increase in peak electrical demand of 5.1 megawatts (85 percent over current NRF electrical demands), and a small increase in consumption of diesel fuel and gasoline. Transition Period: There would be moderate impacts from energy consumption from an increase in electrical demand of 12 megawatts and a small increase in consumption of diesel fuel and gasoline. Small impacts to energy consumption are expected from the increase in consumption of fuel oil, if fuel oil-fired boilers are used. The increased electrical demand for NRF added to the peak load at INL would not exceed the contract demand in the agreement with Idaho Power (45 megawatts).

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Energy Consumption, Site Utilities, and Security Infrastructure Impacts (cont.)			
Energy Consumption (cont.)			New Facility Operational Period: There would be moderate impacts from energy consumption from an increase in electrical demand of 12 megawatts, and no impact from the consumption of diesel fuel and gasoline. The increased electrical demand for NRF added to the peak load at INL would not exceed the contract demand in the agreement with Idaho Power (45 megawatts).
Site Utilities	There would be no impact to site utilities since there would not be any utility modifications.	Refurbishment Period: There would be no impact to site utilities because no site utility modifications would be necessary. Post-Refurbishment Operational Period: There would be no impact to site utilities because no site utility modifications would be necessary.	Construction Period: There would be small to moderate impacts to site utilities due to changes necessary to support construction and operations. Transition Period: There would be no impact to site utilities because no site utility modifications would be necessary. New Facility Operational Period: There would be no impact to site utilities because no site utility modifications would be necessary.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Energy Consumption, Site Utilities, and Security Infrastructure Impacts (cont.)			
Security Infrastructure	There would be no impact to security infrastructure since there would not be any security infrastructure modifications.	<u>Refurbishment Period</u>: There would be beneficial impacts from the construction of a new security boundary system. <u>Post-Refurbishment Operational Period</u>: There would be beneficial impacts from the addition of a new security boundary system.	<u>Construction Period:</u> There would be beneficial impacts from the construction of a new security boundary system. <u>Transition Period</u>: There would be beneficial impacts from the addition of a new security boundary system. <u>New Facility Operational Period</u>: There would be beneficial impacts from the addition of a new security boundary system.
Environmental Justice Impacts			
Environmental Justice	There would be no disproportionately high and adverse impacts to minority or low-income populations since any potential impacts to these populations and the Shoshone-Bannock tribes would be similar to those experienced by the general population. Impacts to all populations are small.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Public and Occupational Health and Safety Impacts			
Non-Radiological Impacts to Workers	While ECF operations continue, there would be no change to impacts from Total Recordable Cases (TRC) and Days Away, Restricted or on-the-job Transfer (DART) cases annually. If operations in ECF cease, there could be a decrease in the number of TRC and DART cases annually.	<u>Refurbishment Period</u>: There would be small impacts from approximately two additional TRCs and less than one additional DART case annually. <u>Post-Refurbishment Operational Period</u>: There would be small impacts from less than one additional TRC and less than one additional DART case annually.	<u>Construction Period</u>: There would be small impacts from less than four additional TRCs and less than two additional DART cases annually. <u>Transition Period</u>: There would be small impacts from less than one additional TRC and less than one additional DART case annually. <u>New Facility Operational Period</u>: There would be no impact from a fractional decrease in the number of TRCs and DART cases annually.
Non-Radiological Impacts to the Public	There would be no impact to the public since construction, refurbishment, and operations activities would take place at NRF approximately 10.5 kilometers (6.5 miles) from the INL property boundary.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Public and Occupational Health and Safety Impacts (cont.)			
Radiological Impacts to Workers	While ECF operations continue, there would be no impact to workers since the individual exposures would not increase. If operations in ECF cease, there would be no naval spent nuclear fuel handling workers and therefore no radiation exposure to those workers.	Refurbishment Period: There would be no impact to workers since individual exposures would not increase. Due to an increase in number of workers, there would be a collective increase in radiological exposure to workers of 0.11 person-Sievert (11 person-rem). Post-Refurbishment Operational Period: There would be no impact to workers since individual exposures would not increase. Due to an increase in number of workers, there would be a collective increase in radiological exposure to the workers of 0.014 person-Sievert (1.4 person-rem).	Construction Period: There would be no impact to workers since exposures from ECF would not increase. Transition Period: There would be no impact to workers since individual exposures would not increase. Due to an increase in number of workers, there would be a collective increase in radiological exposure of 0.011 person-Sievert (1.1 person-rem). New Facility Operational Period: There would be no impact to workers since individual exposures would not increase. Due to a decrease in number of workers, there would be a collective decrease in exposure of 0.011 person-Sievert (1.1 person-rem).

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Public and Occupational Health and Safety Impacts (cont.)			
Radiological Impacts to Individuals Outside ECF or the New Facility	While ECF operations continue, there would be no impact from radiological exposure to individuals outside ECF since a reduction in radiation exposure could occur. If ECF operations cease, radiological exposure would decrease.	Refurbishment Period: There would be no impact to individuals outside ECF since the radiation exposure would not increase. Post-Refurbishment Operational Period: There would be no impact to individuals outside ECF from an increase in exposure since the radiation exposure is negligible compared to annual background radiation exposure.	Construction Period: There would be no impact to individuals outside ECF since radiological exposures from ECF would be negligible. Transition Period: There would be no impact to individuals outside ECF and the new facility from an increase in exposure since the radiation exposure is negligible compared to annual background radiation exposure. New Facility Operational Period: There would be no impact to individuals outside ECF and the new facility from an increase in exposure since the radiation exposure is negligible compared to annual background radiation exposure.
Radiological Impacts from Hypothetical Accident and Intentionally Destructive Act (IDA) Scenario Exposures	There would be no impact since the increased likelihood of fatal cancer from an accident or IDA is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities.		

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts			
Non-Hazardous Solid Waste and Recyclable Materials	While ECF operations continue, there would be no impact since waste generation volumes would not change. If ECF operations cease, waste generation could decrease.	Refurbishment Period: There would be small impacts from an increase in the average annual generation rate of non-hazardous solid waste and recyclable materials of approximately 700 cubic meters (900 cubic yards). Post-Refurbishment Operational Period: There would be small impacts from an increase in the average annual generation rate of non-hazardous solid waste and recyclable materials of approximately 300 cubic meters (400 cubic yards).	Construction Period: There would be small impacts from an increase in the average annual generation of non-hazardous solid waste and recyclable materials of approximately 10,000 cubic meters (13,000 cubic yards). In addition, disposal of 78,000 cubic meters (102,000 cubic yards) of unusable soil could be necessary if the material is not stockpiled near the construction site, or used to backfill an existing gravel pit at NRF, or used to backfill the retired sewage lagoons. Transition Period: There would be small impacts from an increase in the average annual generation rate of non-hazardous solid waste and recyclable materials of approximately 230 cubic meters (300 cubic yards). New Facility Operational Period: There would be no impact from the reduction in the average annual generation rate of non-hazardous solid waste and recyclable materials of approximately 230 cubic meters (300 cubic yards).

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts (cont.)			
RCRA Hazardous Waste	While ECF operations continue, there would be no impact from RCRA hazardous waste since waste generation volumes would not change. If ECF operations cease, RCRA hazardous waste generation could decrease.	<u>Refurbishment Period:</u> There would be small impacts from an increase in the average annual generation rate for RCRA hazardous waste of approximately 25 cubic meters (30 cubic yards). <u>Post-Refurbishment Operational Period:</u> There would be no impact from RCRA hazardous waste since waste generation volumes would not increase.	<u>Construction Period:</u> There would be small impacts from an increase in the average annual generation rate for RCRA hazardous waste from the disposal of unused chemicals remaining after construction. <u>Transition Period:</u> There would be no impact from RCRA hazardous waste since waste generation volumes would not increase. <u>New Facility Operational Period:</u> There would be no impact from RCRA hazardous waste since waste generation volumes would not increase.
TSCA Waste	While ECF operations continue, there would be no impact from TSCA waste since waste generation volumes would not change. If ECF operations cease, TSCA waste generation could decrease.	There would be no impact from TSCA waste during the Overhaul Alternative periods since none would be generated.	There would be no impact from TSCA waste during the New Facility Alternative periods since waste generation volumes would not increase.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts (cont.)			
Solid LLW	While ECF operations continue, there would be no impact from solid LLW since waste generation volumes would not change. If ECF operations cease, solid LLW generation could decrease.	<u>Refurbishment Period:</u> There would be small impacts from an increase in the average annual generation rate for solid LLW of approximately 3550 cubic meters (4640 cubic yards). <u>Post-Refurbishment Operational Period:</u> There would be small impacts from an increase in the average annual generation rate for solid LLW of approximately 850 cubic meters (1100 cubic yards).	<u>Construction Period:</u> There would be no impact on solid LLW generation since none would be generated due to construction activities. <u>Transition Period</u>: There would be small impacts from an increase in the average annual generation rate for solid LLW of approximately 890 cubic meters (1200 cubic yards). <u>New Facility Operational Period</u>: There would be small impacts from an increase in the average annual generation rate for solid LLW of approximately 890 cubic meters (1200 cubic yards).

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts (cont.)			
Radioactive TSCA (PCB) and Radioactive Asbestos Waste	While ECF operations continue, there would be no impact from radioactive TSCA (PCB) or radioactive asbestos waste since waste generation volumes would not change. If ECF operations cease, radioactive TSCA (PCB) or radioactive asbestos waste generation could decrease.	<u>Refurbishment Period:</u> There would be small impacts from an increase in the average annual generation rate for radioactive TSCA (PCB) waste of approximately 3.4 cubic meters (4.4 cubic yards), and an increase in the average annual generation rate for radioactive asbestos waste of approximately 235 cubic meters (310 cubic yards). <u>Post-Refurbishment Operational Period</u>: There would be no impact on radioactive TSCA (PCB) or radioactive asbestos waste since there would be no increase in their generation rates.	<u>Construction Period</u>: There would be no impact on radioactive TSCA (PCB) and radioactive asbestos waste generation since none would be generated due to construction activities. <u>Transition Period:</u> There would be no impact on radioactive TSCA (PCB) and radioactive asbestos waste generation since there would be no increase in generation. <u>New Facility Operational Period</u>: There would be no impact on radioactive TSCA (PCB) and radioactive asbestos waste generation since there would be no increase in generation.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts (cont.)			
MLLW	While ECF operations continue, there would be no impact from MLLW since waste generation volumes would not change. If ECF operations cease, MLLW generation could decrease.	Refurbishment Period: There would be small impacts from an increase in the average annual generation rate for MLLW of approximately 170 cubic meters (230 cubic yards). Post-Refurbishment Operational Period: There would be no impact on MLLW generation since there would be no increase in the generation rate.	Construction Period: There would be no impact on MLLW generation since none would be generated due to construction activities. Transition Period: There would be no impact on MLLW generation since there would be no increase in generation. New Facility Operational Period: There would be no impact on MLLW generation since there would be no increase in generation.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Waste Management Impacts (cont.)			
Liquid LLW	While ECF operations continue, there would be no impact from liquid LLW since waste generation volumes would not change. If ECF operations cease, liquid LLW generation volumes could decrease.	Refurbishment Period: There would be no impact from liquid LLW since waste generation volumes would not change. Post-Refurbishment Operational Period: There would be no impact from liquid LLW since waste generation volumes would not change.	Construction Period: There would be no impact from liquid LLW since none would be generated due to construction activities. Transition Period: Although there could be an increase of approximately 30 liters (8 gallons) in the annual liquid LLW generation rate, there would be no impact since this waste stream is sent off-site to be burned for fuel. New Facility Operational Period: Although there could be an increase of approximately 30 liters (8 gallons) in the annual liquid LLW generation rate, there would be no impact since this waste stream is sent off-site to be burned for fuel.

Table 2.6-1: Comparison of Environmental Impacts for the Project Alternatives (cont.)

Resource/Material Category	No Action Alternative	Overhaul Alternative	New Facility Alternative Location 3/4 and Location 6
Naval Spent Nuclear Fuel Management Impacts			
Naval Spent Nuclear Fuel Management	While ECF operations continue, there would be large impacts on naval spent nuclear fuel management due to management of M-290 shipping containers and work stoppages that would affect fleet performance and the ability to manage naval spent nuclear fuel in accordance with SA 1995 and SAA 2008. If ECF operations cease, there would be large impacts on naval spent nuclear fuel management since the NNPP would eventually be unable to defuel and refuel submarines, leading to the inability of the nuclear-powered ships or their nuclear-trained naval personnel to be deployed or redeployed into fleet operations. Additionally, the NNPP would be unable to meet the requirements of SA 1995 and SAA 2008.	<u>Refurbishment Period:</u> There would be moderate impacts on naval spent nuclear fuel management from temporary work stoppages; however, the facility would be operated to minimize the impact on the NNPP's ability to meet its mission. <u>Post-Refurbishment Operational Period:</u> There would be no impact on naval spent nuclear fuel management since NRF would manage ECF to meet SA 1995 and SAA 2008 despite facility constraints.	<u>Construction Period:</u> There would be small impacts on naval spent nuclear fuel management from temporary mitigation measures needed until the new facility is operational. <u>Transition Period:</u> There would be small impacts on naval spent nuclear fuel management from the inefficiencies of performing naval spent nuclear fuel handling operations concurrently in two separate facilities. <u>New Facility Operational Period:</u> There would be beneficial impacts on naval spent nuclear fuel management once the new facility is fully operational because of increased process efficiencies.

2.6.1 Comparison of Environmental Impacts

Land Use

Differences in impacts to land use from the alternatives are related to the amount of land that is disturbed by construction or refurbishment activities and land required for permanent facilities and supporting infrastructure. The largest impacts from land disturbance are from the construction period of the New Facility Alternative. The New Facility Alternative requires a new facility and supporting infrastructure in addition to a new security boundary system. There is less land disturbance for the Overhaul Alternative than the New Facility Alternative because only a new security boundary system would be built. There are no impacts associated with the No Action Alternative because there would be no land disturbance.

Transportation

Infrastructure

The only impacts to transportation infrastructure are from the construction period of the New Facility Alternative due to the addition of temporary gravel roadways, paved roadways, and additional rail line.

Personnel

Differences in impacts to personnel transportation from the alternatives are related to the traffic from the number of commuter vehicles. Under the No Action Alternative, if ECF operations cease, the average daily traffic could decrease. For the Overhaul Alternative and the New Facility Alternative, there would be small impacts from an increase in traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 due to an increase of commuters; these impacts are largest during the refurbishment period of the Overhaul Alternative (due to an additional 180 commuters) and the construction period of the New Facility Alternative (due to an additional 360 commuters) where there are increases of 3 and 6 percent, respectively. The impacts from the post-refurbishment operational period and the transition period are smaller due to the use of the INL bus by NRF employees.

Material Shipments

Differences in impacts to traffic from the alternatives are related to the number of truck shipments of construction materials (e.g., asphalt, concrete, piping, and building cranes). There would be a negligible impact from transportation of materials during the refurbishment period of the Overhaul Alternative from 1 additional shipment each day. There would be a small impact to traffic from transportation of materials during the construction period of the New Facility Alternative from approximately 50 additional shipments each day.

Waste Shipments

Differences in impacts from transportation of waste are related to waste generation. Under the No Action Alternative, if ECF operations cease, there could be a decrease in the number of shipments. There would be a negligible impact from transportation of non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material during the construction period of the New Facility Alternative.

Geology and Soils

Use of Geologic and Soil Resources

Differences in impacts to geologic and soil resources from the alternatives are related to the excavated materials and borrow materials required for the construction and refurbishment activities. The largest impacts to geologic and soil resources are from the construction period of the New Facility Alternative. The New Facility Alternative requires a new facility and supporting infrastructure in addition to a new security boundary system. Less borrow materials and excavated materials are needed for the Overhaul Alternative than the New Facility Alternative because only a new security boundary system would be built and the water pool refurbished. There would be no excavated materials and no geologic and soil resources required for the No Action Alternative.

Quality of Geologic and Soil Resources

The only impacts to quality of geologic and soil resources occur during the refurbishment period of the Overhaul Alternative and the construction period of the New Facility Alternative. There are no differences in impacts between these alternatives.

Soil Contamination

The only impacts from soil contamination would occur for the No Action Alternative and during the refurbishment period of the Overhaul Alternative if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak.

Volcanic Hazard

There would be no differences in impacts from volcanic hazards for the alternatives. Based on the low probability of occurrence for volcanic hazards, the potential impacts to the alternatives would be negligible.

Seismic Hazards

Differences in impacts from seismic hazards from the alternatives are related to the ability to withstand vibratory ground motions under each alternative. Since there would be no additional refurbishment or upgrades to ECF for the No Action Alternative, the facility and supporting infrastructure would continue to degrade for a period of 45 years.

During the refurbishment period of the Overhaul Alternative, to the extent practicable, infrastructure and equipment would be refurbished or designed to the appropriate natural phenomena hazard category using current design and construction standards to withstand vibratory ground motions.

During the construction and transition periods of the New Facility Alternative, there may be upgrades or refurbishments to ECF to ensure operations continue in a safe and environmentally responsible manner. During the transition and new facility operational periods, the structures, systems, and components in the new facility would be designed to the appropriate natural phenomena hazard category to withstand vibratory ground motions.

Water Resources

Differences in impacts to water resources from the alternatives are related to changes in water quality (i.e., constituent concentrations and discharge volumes) and water use.

Water Quality

Process Wastewater Constituents

The only impacts to constituents in process wastewater would be during the transition and operational periods of the New Facility Alternative. Total output of non-hazardous salts in the IWD effluent could increase under the New Facility Alternative due to increased water softening and de-ionized water treatment processes. Water softening could increase during the transition period due to increased potable water use. De-ionized water treatment could increase during the transition and operational periods due to a larger water pool and the need for replacement water due to evaporation. Under the No Action Alternative (during ECF operations) and Overhaul Alternative, constituents in process wastewater would not change. If ECF operations cease under the No Action Alternative, constituent concentrations could decrease.

Process Wastewater and Storm Water Discharge Volumes

The only impact from discharge volume to the IWD would be from the New Facility Alternative. The largest increase in discharge volume would occur during the construction period. Increases in discharge would be from potential discharges associated with water pool leak testing; however, there would be no impact because the total NRF discharge to the IWD would be within approximately 55 percent of the IWD permit limit. There would be a small impact to the amount of water seeping into the perched water zone at the outfall of the IWD due to the potential increased volume of water discharge. Storm water would be discharged to lined evaporation ponds at Location 3/4. During the construction period, storm water from cleared and compacted construction areas would be managed on-site. Under the No Action Alternative (during ECF operations) and Overhaul Alternative, discharge volumes to the IWD would not change. If ECF operations cease under the No Action Alternative, discharge volumes to the IWD could decrease.

Discharge Volumes to the Active Sewage Lagoons

The largest increase from discharge volume to the active sewage lagoons would be from the refurbishment period of the Overhaul Alternative from the increase of 180 refurbishment workers. Increases during the post-refurbishment operational period of the Overhaul Alternative, and the transition period would also occur due to the increase of 50 and 45 naval spent nuclear fuel handling workers, respectively. However, there would be no impacts because the total discharge would be within the design operating parameters of the active sewage lagoons. Under the No Action Alternative, while operations in ECF continue, discharge volume of sanitary wastewater to the active sewage lagoons would not change. If operations in ECF cease under the No Action Alternative, there could be a decrease in discharge volume to the active sewage lagoons. During the construction period of the New Facility Alternative, discharge volume of sanitary wastewater to the active sewage lagoons would not change due to the use of portable sanitary sewer systems. During the new facility operational period, the work force would decrease by about 110 personnel resulting in small decrease in sanitary wastewater discharge.

Groundwater

There would be negligible impacts to groundwater under the No Action Alternative and the refurbishment period of Overhaul Alternative from radiological constituents if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak. There could be small impacts to groundwater during the transition period and new facility operational period under the New Facility Alternative from potential increases in non-hazardous salts in wastewater discharge.

Drinking Water

The only impacts to drinking water would occur under the No Action Alternative and the refurbishment period of Overhaul Alternative. There would be negligible impacts on drinking water sources if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak.

Groundwater Use

The extent of groundwater use varies amongst alternatives; however, where there is an increase in the volume of groundwater used, the increase is negligible in comparison to the Federal Reserved Water Right for INL. The largest increases in water use occur for the New Facility Alternative. During the construction period, water use would increase from dust control, soil and engineered fill compaction, equipment washing and flushing, landscaping, water pool leak test, final water pool fill, and batch plant operations. During the transition period, water use would increase due to increased work force (45 personnel), from replacing evaporated water from water pools larger than those in ECF, fire water usage during testing, and landscape irrigation. During the operations period, potable water use would decrease due to decreased work force (110 personnel), but there would be a net increase due to non-potable water used for replacing evaporated water from water pools larger than those in ECF, fire water usage during testing, and landscape irrigation. During the refurbishment period of the Overhaul Alternative, water use would increase due to increased workforce (180 personnel) and for activities such as washing equipment and tools, concrete saw cutting, and concrete drilling. Under the No Action Alternative (while ECF operations continue) groundwater use would not change. If ECF operations cease under the No Action Alternative, there could be a decrease in groundwater use.

Ecological Resources

Vegetation

Differences in impacts to vegetation from the alternatives are related to area of land disturbance. The primary impacts to vegetation would be loss or disturbance during construction activities and potential for invasion of disturbed areas by noxious weeds and non-native plants. The impacts would occur during the refurbishment period of the Overhaul Alternative and the construction period of the New Facility Alternative. The largest impacts would occur during the construction period of the New Facility Alternative since the area disturbed is larger than during the refurbishment period of the Overhaul Alternative. During the construction period, land disturbance at Location 6 would result in the greatest impacts since Location 6 is currently less disturbed than Location 3/4. Location 6 is also dominated by native species while Location 3/4 is dominated by non-native species. For the No Action Alternative, post-refurbishment period of the Overhaul Alternative, and transition and new facility operational periods of the New Facility Alternative, no additional land disturbance would occur.

Wildlife

Differences in impacts to wildlife from the alternatives are related to area of land disturbance and level of activity. The primary impacts to wildlife would be habitat loss and fragmentation, localized death and injury, and noise. Noise during construction could result in avoidance of the construction areas and adjacent habitat. Land clearing during construction of the new security boundary system during the refurbishment period of the Overhaul Alternative and construction of new facility structures during the construction period of the New Facility Alternative could result in mortality of small animals. Large animals would avoid the area due to the increase in noise levels. These impacts would be largest for the construction period of the New Facility Alternative due to the larger area that would be disturbed.

If ECF operations cease under the No Action Alternative, there could be a decrease in localized death and injury and a decrease in noise due to a decrease in activity levels.

Air Quality

Non-Radiological Air Emissions

Differences in impacts from non-radiological air emissions from the alternatives are related to increases in non-radiological air pollutant emissions. These pollutant emissions can affect visibility, ozone, and deposition. The impacts to non-radiological air emissions from the New Facility Alternative are due to an increase in criteria, toxic, and PSD air pollutant emissions. During the construction period, these impacts would be small for criteria and PSD air pollutant emissions and negligible for toxic air pollutant emissions. The impacts result from construction activities such as excavation, use of diesel generators, and equipment operation. During the transition and new facility operational period, the increases are from boiler emissions associated with heating a larger facility and greater power requirements for the emergency diesel generators. However, impacts would be negligible and all air quality standards would be met for criteria, toxic, and PSD air pollutants at INL receptor locations. PSD and visibility standards would be met for Federal Class I areas. For the Overhaul Alternative, the construction of the new security boundary system during the refurbishment period would generate intermittent fugitive dust and equipment emissions, and there would be an increase in workforce traffic, resulting in negligible impact to non-radiological air emissions. The increase in workforce traffic would also result in a negligible impact to non-radiological air emissions. Non-radiological air emissions would not change for the No Action Alternative.

Greenhouse Gases

Increases in GHGs impact global climate change. With the exception of the No Action Alternative, there would be no differences in climate change impacts from GHGs for the alternatives. GHG emissions would not increase under the No Action Alternative; therefore, impacts on global climate change would not change. Impacts on global climate for the Overhaul Alternative would be negligible and primarily due to increases in GHGs from worker commute or purchased electricity. Impacts on global change for the New Facility Alternative would be negligible for the construction, transition, and operational periods. During construction, these impacts would be primarily due to increases in GHGs from worker commute, operation of construction equipment, and use of diesel generators. During the transition and operational periods, impacts would be primarily due to increases in GHGs from purchased electricity and fuel oil-fired boilers used for heat. Increased worker commuting would also contribute during the transition period.

There would be no differences in impacts from global climate change for the alternatives. If global GHG emissions remain at or above current rates, impacts on global climate change will continue to occur. Continued climate change could pose threats to infrastructure and risk to worker health and safety through increased frequency and severity of extreme weather events (e.g., drought, thunderstorms, strong winds, hail, tornadoes, snow storms, dust devils, and wildfires). There is also potential for persistent drought to increase risk of power disruptions during summer months, when water shortages could lead to decreased energy production from the region’s electricity facilities. Increased temperatures resulting in additional cooling demands in the summer may also impact the proposed action by contributing to power disruption or by increasing stress on cooling systems. These potential vulnerabilities can be mitigated through existing NRF safety, operations, and emergency planning processes. Therefore, impacts of climate change would be small for the alternatives.

Radiological Air Emissions

Differences in impacts from radiological air emissions from the alternatives are related to changes in radiological air pollutant emissions. Radiological air emissions could decrease for the No Action Alternative while operations continue due to the decrease in the operational pace at ECF. There would be no radiological emissions from the No Action Alternative if operations in ECF cease or from the construction period of the New Facility Alternative since construction would not involve any radioactive materials or produce any radiological emissions. Radiological air emissions would not change for the refurbishment period of the Overhaul Alternative due to the reduced pace of operations at ECF. For the post-refurbishment operational period of the Overhaul Alternative, the transition period of the New Facility Alternative, and the new facility operational period, radiological emissions would increase from operations at maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters. However, the increase in emissions would represent less than 0.03 percent of INL emissions.

Noise

Differences in impacts from noise between the alternatives are related to the increase in traffic along U.S. Highway 20, U.S. Highway 26, and State Route 33. Noise levels would not change for the No Action Alternative (while ECF operations continue), the post-refurbishment operational period of the Overhaul Alternative, the transition period of the New Facility Alternative, and the new facility operational period. For the refurbishment period of the Overhaul Alternative and the construction period of the New Facility Alternative, local noise levels would increase, due to the increase in traffic; therefore, the increase in noise would be negligible to public and sensitive receptors located along U.S. Highway 20, U.S. Highway 26, and State Route 33. If ECF operations cease under the No Action Alternative, there could be a reduction in noise levels.

Cultural Resources and Historic Properties

Differences in impacts to cultural resources from the alternatives are related to the location of disturbance areas and whether cultural resources are present in that area. The only impacts are from the construction period of the New Facility Alternative. For the construction period of the New Facility Alternative, small archaeological sites that have been identified are not eligible for listing on the National Register of Historic Places; however, the historical record described in the INL Cultural Resources Management Plan supports the conclusion that the INL site, including the proposed disturbance areas, is located within a large original territory of the Shoshone-Bannock people, and archaeological and other cultural resources reflect the importance of the area to the Tribes that are located there. Construction of a new facility at NRF would have small unavoidable impacts to Native American cultural resources. There would be no land disturbance from the No Action Alternative. During the refurbishment period of the Overhaul Alternative, a new security boundary system would be constructed; however, there are no cultural resources or historic properties in the land disturbance area.

Visual and Scenic Resources

There would be no differences in impacts to visual and scenic resources from landscape contrast or deterioration of the landscape. No new structures would be built for the No Action Alternative. The new security boundary system constructed for the Overhaul Alternative would be at ground level and would not be visible from surrounding areas. The structures associated with the New Facility Alternative would be consistent with the current visual character of NRF.

Socioeconomic Impacts

Differences among the alternatives are related to the number of workers and the resulting population increase from in-migration to the ROI. In-migration to the ROI varies based on assumptions about the workforce. It is assumed that 3 percent of the construction and refurbishment workforce would be non-local workers, and 70 percent of the naval spent nuclear fuel handling workers would be non-local workers during operational periods.

Employment

The largest impact to direct employment in a single year is from the construction period of the New Facility Alternative. However, the largest overall impact to direct employment is from the increase in 180 construction workers during the refurbishment period of the Overhaul Alternative. The increase of 180 construction workers during the refurbishment period is a larger overall impact than the increase of 360 construction workers during the construction period because of the duration of the impact (i.e., 33 years for the refurbishment period versus 3 years for the construction period). There would be no change to the number of naval spent nuclear fuel handling workers at NRF for the No Action Alternative while operations continue in the ECF. If ECF operations cease, the number of workers at NRF would decrease.

ROI Population Increase

The ROI population would not change for the No Action Alternative while operations in the ECF continue. If ECF operations cease, there may be decreases in the ROI population. For the Overhaul and New Facility Alternatives, the ROI population would increase the most from the Overhaul Alternative post-refurbishment period. However, the largest ROI population increase would only increase the ROI population by 0.04 percent. The differences in ROI population changes result from the assumptions about in-migration that vary based on the number of workers that would be local and non-local.

Housing Vacancies

The percent of vacant housing would not change for the No Action Alternative while operations in the ECF continue. If ECF operations cease, there could be an increase in housing vacancies. For the Overhaul and New Facility Alternatives, the decrease in vacant housing would be the largest during the post-refurbishment operational period of the Overhaul Alternative. However, the largest decrease in vacant housing would only decrease the percent of vacant housing in the ROI by less than 1 percent. The differences in housing vacancy changes result from the assumptions about in-migration that vary based on the number of workers that would be local and non-local.

Taxes

The largest annual increase to local and state revenues would be from the construction period of the New Facility Alternative based on a workforce of 360 construction workers. The differences in the local and state revenues among the alternatives are a result of the differences in workforce changes. There would be no change in local and state revenues from the No Action Alternative while operations in the ECF continue since the number of naval spent nuclear fuel handling workers at NRF would not change. Under the No Action Alternative, if ECF operations cease, there could be a decrease in the amount of local and state revenues resulting from a decrease in the number of workers.

Public Service Levels

The largest increase to public service levels would be from the transition period of the New Facility Alternative. The differences in public service level impacts result from the assumptions about in-migration that vary based on the number of workers that would be local and non-local. For the No Action Alternative while operations in the ECF continue, public service levels would not change since the number of naval spent nuclear fuel handling workers at NRF would not change. Under the No Action Alternative, if ECF operations cease, there would be no impact to public service levels since fewer teachers and no additional police officers or firefighters would be required to maintain current levels of service.

Energy Consumption, Site Utilities, and Security Infrastructure

Energy Consumption

Differences among the alternatives are related to the increase in electrical demand and whether or not the demand exceeds the capability of the INL electrical infrastructure. The New Facility Alternative would have the largest impacts from energy consumption during the transition period and new facility operational period. During these time periods, there would be an increase in electrical demand of 12 megawatts which, when added to peak INL load, would not exceed the contract demand in the agreement with Idaho Power (45 megawatts). For the refurbishment period of the Overhaul Alternative, there would be an increase in electrical demand of approximately 0.5 megawatts. For the No Action Alternative and post-refurbishment period of the Overhaul Alternative there would be no increase in electrical demand.

Site Utilities

Differences among the alternatives are related to the extent of changes to water and electrical systems needed to support the alternatives. The New Facility Alternative would have the largest impacts from changes to site utilities. For the New Facility Alternative, impacts to the site utilities would be made to support construction and operations. The potable water system and the sanitary sewer system would be modified by adding length of pipe. Additional tanks, pumps, and piping may be added for the fire water system. At Location 6, a pump and lift station could be installed (if necessary) and the drainage system would be tied into the existing storm water line. At Location 3/4, a local storm water collection system would discharge water by gravity flow into local lined evaporation ponds. For the No Action Alternative and the Overhaul Alternative, no modifications to site utilities would be necessary.

Security Infrastructure

Differences among the alternatives are related to the extent of changes to the security infrastructure. For the No Action Alternative, there would be no security infrastructure changes. For the Overhaul Alternative and the New Facility Alternative, a new security boundary system would be constructed. During the construction period of the New Facility Alternative, a personnel fence would separate the operational areas of NRF from the construction workers.

Environmental Justice Impacts

Impacts to environmental justice populations and the Shoshone-Bannock tribes would be similar to those experienced by the general population.

Public and Occupational Health and Safety Impacts

Non-Radiological Impacts to Workers

Differences among the alternatives are related to the number of workers. TRCs and DART cases increase or decrease proportionately to number of workers required. The largest annual increase in TRCs and DART cases would be from the construction period of the New Facility Alternative consistent with the 360 construction workers necessary for that alternative. For the No Action Alternative while operations in ECF continue, additional workers would not be required; therefore, there would be no change to the TRCs and DART cases. If ECF operations cease under the No Action Alternative, there would be a decrease in the number of workers and associated TRC and DART cases.

Radiological Impacts to Workers

The radiation exposure to an individual naval spent nuclear fuel handling worker would not change for any alternative. The collective radiation exposures differ between the periods and alternatives because they are related to the number of workers. The refurbishment period of the Overhaul Alternative would have the largest increase in collective exposure due to the exposure of 180 refurbishment workers. If operations in ECF cease under the No Action Alternative, there would be no naval spent fuel handling workers and therefore no radiation exposure to those workers. During the construction period of the New Facility Alternative, radiation exposure from ECF operations to construction workers would be negligible.

Radiological Impacts to the Public

If operations in ECF cease under the No Action Alternative, there will be no public radiation exposure. Radiation exposure to the public could be reduced during the No Action Alternative while operations in ECF continue or if operations in ECF cease. Radiation exposure to the public would not increase during the refurbishment period of the Overhaul Alternative. During the post-refurbishment operational period of the Overhaul Alternative, the construction period, transition period, and new facility operational period of the New Facility Alternative, there would be an increase in public exposure due entirely to conservatively assuming the respective facilities are operated at maximum capacity. This increase in exposure is negligible compared to annual background radiation exposure.

There would be no difference in impact to the public from a hypothetical accident scenario or an IDA. The increased likelihood of fatal cancer from an accident or IDA is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities.

Waste Management

Differences in impacts to waste management from the alternatives are related to the volume of waste generated.

Non-Hazardous Solid Waste and Recyclable Materials

The greatest increase in non-hazardous solid waste and recyclable materials from all alternatives comes from the construction period of the New Facility Alternative; the majority of the increase comes from the disposal of unsuitable surface soil associated with the footprint of the new facility. The volume of unsuitable surface soil is based on the conservative assumption that the soil could not be re-used on-site and would need to be disposed of instead. The non-hazardous and recyclable waste generation rates during the transition period and the new facility operational period are based on the increase and decrease, respectively, in the naval spent nuclear fuel handling workforce.

For the Overhaul Alternative, the increase in generation of non-hazardous solid waste and recyclable materials results from the increase in 180 refurbishment workers during the refurbishment period and an increase in 80 naval spent nuclear fuel handling workers during the post-refurbishment operational period.

Under the No Action Alternative if ECF operations cease, non-hazardous solid waste and recyclable materials generation could decrease.

RCRA Hazardous Waste

The greatest increase in RCRA hazardous waste generation from all alternatives comes from the refurbishment period of the Overhaul Alternative from activities such as paint and equipment removal. The construction period of the New Facility Alternative would also have an increase in RCRA hazardous waste generation from the disposal of unused chemicals remaining after construction. Under the No Action Alternative if ECF operations cease, there could be a decrease in the generation of RCRA hazardous waste.

TSCA Waste

If ECF operations cease under the No Action Alternative, there could be a decrease in the generation of TSCA waste. For all other alternatives, TSCA waste would not be generated or waste generation volumes would not increase.

Solid LLW

The refurbishment period of the Overhaul Alternative has the greatest increase in solid LLW generation from all alternatives. This increase is primarily from the refurbishment activities. The New Facility Alternative (transition and operational periods) increases are attributed to additional waste from processing naval spent nuclear fuel that arrives in M-290 shipping containers, and from the water purification system (resin and filter waste). The increase in the solid LLW generation rate from the transition and operational periods of the New Facility Alternative is higher than the increase in the solid LLW generation rate for the post-refurbishment operational period of the Overhaul Alternative because the generation rate for the New Facility Alternative includes processing and water purification system waste, while the Overhaul Alternative generation rate only includes processing waste. If ECF operations cease under the No Action Alternative, solid LLW generation could decrease.

Radioactive TSCA (PCB) Waste and Radioactive Asbestos Waste

Only the refurbishment period of the Overhaul Alternative would have an increase in the radioactive TSCA (PCB) waste and radioactive asbestos waste generation rates. The bulk of this waste would be generated during asbestos abatement included in the refurbishment work. If ECF operations cease under the No Action Alternative, radioactive TSCA (PCB) or radioactive asbestos waste generation could decrease.

MLLW

Only the refurbishment period of the Overhaul Alternative would have an increase in the MLLW generation rate, due to refurbishment activities such as decontamination of facilities. If ECF operations cease under the No Action Alternative, MLLW generation could decrease.

Liquid LLW

Only the transition and operational periods of the New Facility Alternative would have an increase in the generation of liquid LLW. If ECF operations cease under the No Action Alternative, liquid LLW generation could decrease.

Naval Spent Nuclear Fuel Management

Differences in impacts to naval spent nuclear fuel management from the alternatives are related to meeting the needs of the U.S. Navy nuclear-powered fleet and the requirements of SA 1995 and SAA 2008. The largest impacts would be from the No Action Alternative due to 1) work stoppages associated with continuing ECF operations that could affect fleet performance and the ability to manage naval spent nuclear fuel in accordance with SA 1995 and SAA 2008, and 2) the eventual inability to defuel and refuel submarines that would result if ECF operations were to cease altogether. Additionally, the NNPP would be unable to meet the requirements of SA 1995 and SAA 2008 if ECF operations ceased. During the refurbishment period of the Overhaul Alternative, there would be temporary work stoppages; however, the facility would be operated to minimize the impact on the NNPP's ability to meet its mission. NRF would manage ECF to meet SA 1995 and SAA 2008, despite facility constraints during the post-refurbishment period of the Overhaul Alternative. During the construction period of the New Facility Alternative, temporary mitigation measures would be needed until the new facility is operational. During the transition period, there would be inefficiencies of performing naval spent nuclear fuel handling operations in two facilities (ECF and the new facility). The operational period of the new facility would benefit from process efficiencies.

2.6.2 Comparison of Costs

Cost estimates provided in Table 2.6-2 are rough order of magnitude estimates for acquisition costs (e.g., cost of construction, refurbishment, and equipment). Costs associated with the No Action Alternative are not presented, as this alternative is not reasonable. Costs for the Overhaul Alternative are higher than that for the New Facility Alternative due to the higher cost to refurbish ECF while continuing to operate in parallel. Although not explicitly presented here, maintenance and operational manpower costs for the Overhaul Alternative would also be higher than for the New Facility Alternative due to the increasing costs of maintaining existing infrastructure. The New Facility Alternative would reduce the current maintenance burden, avoid expensive repairs and overhauls, integrate streamlined work flows to increase operational capacity, and incorporate energy efficient technologies, while reducing operational costs.

Table 2.6-2: Cost of the Proposed Action

Overhaul Alternative	New Facility Alternative	
	Location 3/4	Location 6
Then-Year Dollars[1]	Then-Year Dollars[1]	
$6.01 billion	$1.65 billion	$1.68 billion

[1]These costs are based on the impacts associated with the FY14 Consolidated Appropriations Act and updated estimates. They are based on the best available information and are subject to change based on the timing of the proposed action and availability of funds.

2.7 Preferred Alternative

Council on Environmental Quality regulations require the federal agency to identify its preferred alternative to fulfill its statutory mission, if one or more exists, in a Draft EIS (40 C.F.R. § 1502.14). Because the impacts to human health and the environment for all the alternatives would primarily be small, all alternatives are considered to be comparable and indistinguishable under these criteria. In this EIS, the preferred alternative to recapitalize the infrastructure supporting naval spent nuclear fuel handing is to build a new facility (New Facility Alternative) at Location 3/4.

New Facility Selection

Recapitalizing the infrastructure and processes for naval spent nuclear fuel handling by building a new facility will improve long-term capacity, increase efficiency and effectiveness, and reduce long-term costs and risks. While the ECF continues to be operated in a safe and environmentally responsible manner, the reliability of the existing facility will continue to decrease because of aging infrastructure and equipment.

The existing infrastructure at ECF was not built to current day design codes and standards. Consequently, the overall level of effort required to reliably and safely operate the existing facility is increasing. A major benefit of the New Facility Alternative is that the facility would be built to current design and construction standards.

Implementation of the New Facility Alternative would improve the ability to meet long-term mission needs and anticipated future production capacities. The capability to unload naval spent nuclear fuel from an M-290 shipping container into the water pool to examine, transfer, prepare, and package for disposal is not currently available in ECF. Upgrading ECF for new capabilities is not currently feasible without facility, process, and equipment reconfigurations. This may result in work stoppages which would temporarily impact the mission critical work and delay processing of naval spent nuclear fuel into dry storage. The New Facility Alternative would be more cost effective than the ECF reconfigurations necessary to install new equipment into the constrained space as part of the Overhaul Alternative. In addition, the ECF naval spent nuclear fuel handling infrastructure continues to age and more extensive and complex sustainment efforts continue to be needed. The ability of the existing ECF infrastructure to meet the long-term needs of the NNPP will continue to decrease.

The new facility would be an opportunity to improve the effectiveness of naval spent nuclear fuel handling. The new facility would be designed with the production capacity to meet fleet demands based on lessons learned from over 50 years of operating ECF. Incremental facility changes and additions to the ECF have resulted in facility and process configuration constraints that cause less than optimal work flow. The recapitalized infrastructure under the New Facility Alternative would eliminate ECF's constraints by optimizing the product flow and designing a facility configuration to house the optimized product flow.

Another benefit of more efficient processes under the New Facility Alternative is the enhanced ability to meet SA 1995, as amended (SAA 2008). This agreement includes limitations on quantity and duration of naval spent nuclear fuel in water pools. For example, naval spent nuclear fuel may only be managed in a water pool for 6 years. The recapitalized infrastructure will provide a more reliable and efficient production line, providing added assurance that those requirements will be met.

Location Selection

Section 2.1.3 describes evaluation criteria used to determine which locations on NRF would be good for new facility construction. Section 2.1.3 also discusses the use of existing assets at NRF. The primary difference between locating a facility at Location 3/4 and Location 6 would be the extent to which existing assets could be used. A new facility at Location 3/4 would utilize the existing OSB, OSEs, and the CSRF, minimizing ground disturbance and construction impacts. Therefore, Location 3/4 is preferred to Location 6.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

For many years, Naval Reactors Facility (NRF) and Idaho National Laboratory (INL) subcontractors have conducted environmental monitoring to demonstrate that NRF and INL are being operated in accordance with environmental standards. The results have been published in the NRF and INL annual reports provided to federal, state, and local officials. These publicly available reports demonstrate that NRF's practices meet the requirements of applicable laws and regulations. The monitoring results confirm compliance with environmental standards.

NRF has had environmental control programs in place since 1953. The objective of these programs has been to meet or exceed the requirements of laws and regulations applicable at the time. NRF has established and maintained levels of radioactivity control that are equal to and in many cases far more stringent than applicable requirements. After five decades of operation, NRF has had no significant impact on the quality of the environment or adverse effect on the surrounding communities.

NRF's operations and environmental performance are subject to continuous oversight by resident representatives of the Naval Nuclear Propulsion Program (NNPP). Periodic in-depth reviews and inspections are also conducted by personnel from NNPP headquarters and the Knolls and Bettis Laboratories. In addition to NNPP reviews and inspections, NRF environmental programs are inspected by the state of Idaho and the Environmental Protection Agency (EPA) in accordance with their regulatory authority. These inspections have found site operations to be in compliance with all applicable requirements.

This section provides a summary of the current environmental conditions for the Region of Influence (ROI) considered in this Environmental Impact Statement (EIS). Conditions on the INL and surrounding communities are provided where appropriate with a focus on the NRF. The environmental conditions described are those currently present. This information provides the basis for evaluating the impacts of the alternatives in Chapter 4.

3.1 Land Use

INL Land Use

The INL, and the lands immediately adjacent to the INL boundary, comprise the ROI for the affected environment for specific land uses. For each type of land use, the geographic boundaries are delineated. Because the majority of INL is located in Butte County, the land use in the county, closest neighboring communities, and nearby tourist and recreation attractions is characterized in a general manner without the specific geographic delineation of each land use. These areas are generally described because they are included in the ROI for other aspects of the affected environment. For example, areas that could be impacted by INL emissions (Craters of the Moon National Monument and Grand Teton and Yellowstone National Parks) are described as nearby land uses because these areas are considered in the ROI for air quality.

The INL is located on approximately 230,700 hectares (570,000 acres) of land in southeastern Idaho. INL is located primarily within Butte County, but portions are in Bingham, Jefferson, Bonneville, and Clark counties. Figure 3.1-1 shows the regional location of INL. The INL is roughly equidistant from Salt Lake City, Utah and Boise, Idaho. There are no permanent residents at INL.

The Department of Energy (DOE) is the federal agency designated with the responsibility and authority for effectively managing INL lands, in accordance with a series of Land Withdrawal Public Land Orders that include about 204,900 hectares (506,000 acres) (NRC 2004). In addition, approximately 8500 hectares (21,000 acres) of state land, and 17,400 hectares (43,000 acres) of private land were transferred to DOE ownership and management between the1940s and the 1960s, for a total of 230,700 hectares (570,000 acres). DOE is responsible for ensuring that the future use and management of these lands are in accordance with the Public Land Orders.

Most of INL is undeveloped, high-desert terrain. Only about 4600 hectares (11,400 acres) have been developed to support facility and program operations at eight primary facility areas associated with energy research and waste management activities (Figure 3.1-2). These facilities are located within an approximately 93,000 hectare (230,000 acre) central core of INL. An 18,200-hectare (45,000-acre) security and safety buffer surrounds the developed area. Additionally, approximately 13,800 hectares (34,000 acres) of INL are developed for utility rights-of-way and public roads (DOE 2011c). United States (U.S.) Highway 20 runs east and west and crosses the southern portion of INL; U.S. Highway 26 runs southeast and northwest and crosses the southwestern portion of INL; Idaho State Highways 22, 28, and 33 cross the northeastern part of INL.

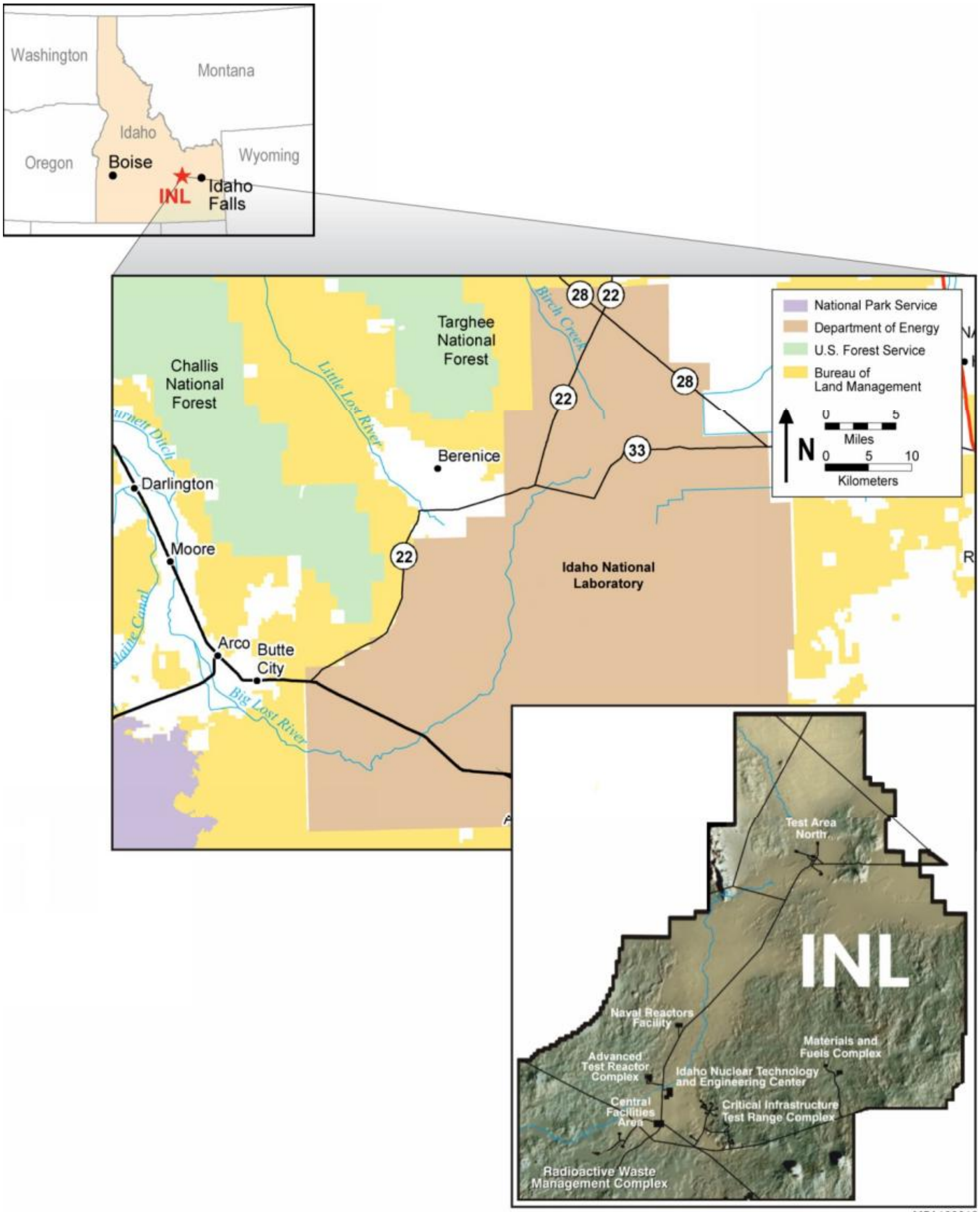
On July 17, 1999, the Secretary of Energy and representatives of the U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), and Idaho Department of Fish and Game designated 29,650 hectares (73,260 acres) of INL as the Sagebrush Steppe Ecosystem Reserve. The National Biological Service, in 1995, identified the sagebrush steppe ecosystem as critically endangered across its entire range. INL's Sagebrush Steppe Ecosystem Reserve, designated to ensure this portion of the ecosystem receives special consideration, is located in the northwest portion of the area (NRC 2004). The southern boundary of the reserve runs east and west along section lines and is approximately 10 kilometers (6 miles) north of NRF at the closest point. A final management plan was established for the Reserve in 2004 (DOE 2004a).

Approximately 60 percent of INL is open for livestock grazing (ESER 2008). Grazing permits are administered by the BLM. Livestock grazing, however, is prohibited within 0.8 kilometers (0.5 miles) of any primary facility boundary and within 3.2 kilometers (2 miles) of any nuclear facility (NRC 2004). Livestock grazing is also permitted on the Sagebrush Steppe Ecosystem Reserve (Figure 3.1-2).

Approximately 94 percent of INL land is open and undeveloped. The land is covered predominantly by sagebrush and grasslands. Pastures, foothills, and farmlands border much of INL, with the agricultural activity concentrated in areas northeast of INL. The Bitterroot, Lemhi, and Lost River mountain ranges border INL on the north and west; volcanic buttes and open plains are located near the southern boundary of INL (ESER 2008). The mountain ranges are used for recreational activities and for livestock grazing; mining occurred in these mountains in the past and there are mineral rights for several locations on INL. The Eastern Butte is used for radio tower reception.

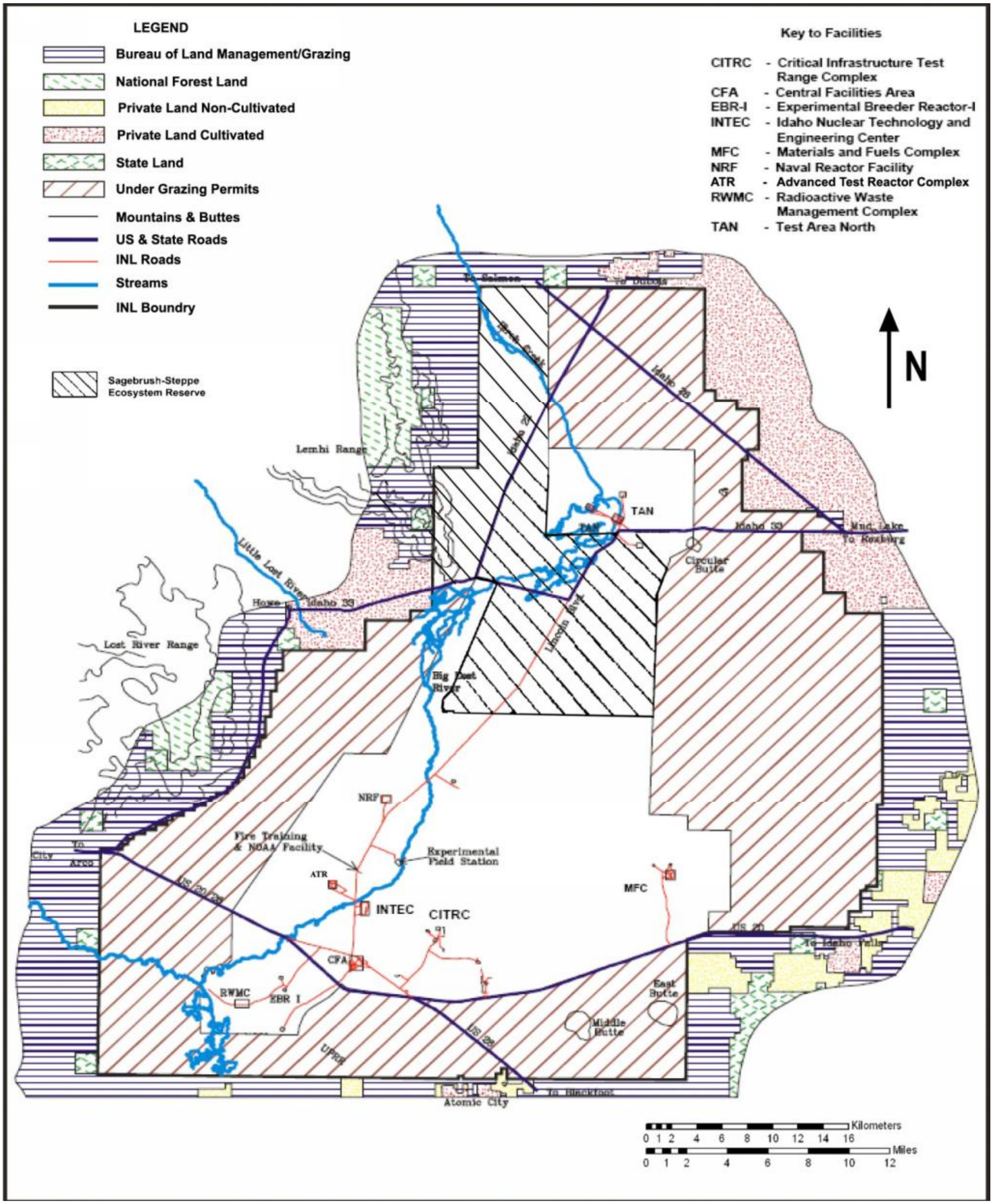
Geographically, INL is included within a large territory once inhabited by, and still of importance to, the Shoshone-Bannock Tribes. Cultural resources include not only archaeological sites affiliated with the Shoshone-Bannock history, but also many kinds of natural resources, such as plants and animals traditionally used by the Tribes. Finally, features of the natural landscape, such as buttes, rivers, and caves, often have particular significance to the Shoshone-Bannock people (NRC 2004). Refer to Section 3.8.1 for additional information.

Controlled hunting is permitted on INL to assist the Idaho Department of Fish and Game in reducing crop damage caused by wild game on adjacent private agricultural lands. These hunts are restricted to specific locations. INL is a designated National Environmental Research Park, functioning as a field laboratory set aside for ecological research and evaluation of the environmental impacts from nuclear energy development. INL does not lie within any land boundaries established by the Fort Bridger Treaty of 1868; the entire INL is land occupied by the DOE. Therefore, the provisions in the Fort Bridger Treaty that allow the Shoshone-Bannock Tribes to hunt on unoccupied lands of the United States do not apply to INL (NRC 2004). However, as described in Section 3.8, DOE accommodates Tribal member access to areas on the INL for subsistence and religious uses.



Source: DOE 2011c

Figure 3.1-1: Regional Location of INL



Source: INL 2007

Figure 3.1-2: INL Facilities and Land Uses

NRF Land Use

NRF is the location of the proposed action on INL. NRF, by air distance, is approximately 80 kilometers (50 miles) from the population centers of Pocatello (located to the south), Idaho Falls, Rigby, and Rexburg (located to the east). Blackfoot is located about 65 kilometers (40 miles) to the southeast. The developed portions of NRF are primarily for industrial use. NRF is managed by the U.S. DOE Office of Naval Reactors, Idaho Branch Office. The developed portion of NRF within the secured perimeter covers about 34 of the approximately 1800 total hectares (84 acres of the approximately 4400 total acres). The land outside the secured perimeter at NRF is similar to the other undeveloped land at INL.

Land Use Adjacent to INL

Approximately 75 percent of the land adjacent to INL is managed by the federal government and administered by the BLM for wildlife habitat, mineral and energy production, grazing, and recreation. Approximately 1 percent of the adjacent land is owned by the state of Idaho and used for purposes similar to that of the federal government. Private owners hold the remaining 24 percent of the land adjacent to INL. This portion of the land is used primarily for grazing and crop production (NRC 2004). Small farming communities are located on the west central and northwestern boundaries. Most of the eastern boundary of INL borders land used for agriculture and grazing.

Figure 3.1-2 shows INL facilities, the land use at INL, and the use of the adjacent land. The U.S. Sheep Experiment Station, located on 365 hectares (900 acres) on the northeast boundary of INL at the junction of State Route 28 and State Route 33, serves as a winter feedlot for sheep (NRC 2004). In addition to the land use, there are rivers, streams, and Mud Lake located adjacent to INL that provide recreational opportunities including fishing and boating. The region surrounding INL has recreation and tourist attractions including Yellowstone National Park, Grand Teton National Park, Jackson Hole Recreation Complex, Craters of the Moon National Monument, Challis National Forest, Targhee National Forest, Beaverhead Deer National Forest, Camas National Wildlife Refuge, Black Canyon Wilderness Area, Hell's Half Acre National Natural Landmark, Big Southern Butte, and Wildlife Management Areas (Market Lake and Mud Lake). The Craters of the Moon National Monument is approximately 21,500 hectares (53,100 acres) of moon-like landscape that was created by volcanic eruptions that began 15,000 years ago and ended about 2000 years ago. This monument was established to preserve the unique geological and biological features that exist there (NPS 2010). The Craters of the Moon National Monument is approximately 54 kilometers (34 miles) west of NRF. The national parks and recreational areas are used for many outdoor activities such as hiking, biking, camping, skiing, snowmobiling, fishing, and rafting.

Communities that are closest to INL include Atomic City (south), Arco (west), Butte City (west), Howe (northwest), Mud Lake (northeast), and Terreton (northeast). In the counties surrounding INL, approximately 45 percent of the land is for agriculture, 45 percent is open land, and 10 percent is urban. (DOE 2006)

The site of the proposed action is in Butte County, which covers approximately 578,300 hectares (1,429,100 acres). The majority of INL is located in Butte County. Butte County controls 18 percent of the land; the remaining 82 percent of the land is under federal and state government control. The county is zoned for agriculture, transitional agriculture, residential, industrial, and commercial. Butte County has approximately 27,000 hectares (66,500 acres) of irrigated crop land. Butte County commercial crops include alfalfa hay, grain, and potatoes; livestock on the rangelands are cattle and sheep. For the remaining federal and state government controlled land, the BLM controls approximately 234,000 hectares (578,200 acres), the Challis National Forest contains approximately 100,000 hectares (247,100 acres), Targhee National Forest contains approximately 20,600 hectares

(51,000 acres), the DOE controls approximately 230,300 hectares (569,100 acres); there are approximately 14,300 hectares (35,300 acres) of state endowment fund lands in Butte County.

Land Use in Other Surrounding Areas

Land use planning in the state of Idaho is derived from the Local Planning Act of 1975. The state of Idaho does not have a land-use planning agency (DOE 2002c). Therefore, the Idaho legislature requires that each county adopt its own land-use planning and zoning guidelines. At present, most of the surrounding counties have implemented guidelines to focus development adjacent to previously developed areas, with a goal of avoiding urban sprawl and the pressures that it might place on existing infrastructure (NRC 2004). The largest city situated close to INL is Idaho Falls, the largest urban development in Eastern Idaho; Pocatello and Blackfoot are also close to INL.

Because INL is remotely located, adjacent areas are not likely to experience residential and commercial development. However, recreational and agricultural uses are expected to increase in the surrounding area, in response to greater demand for recreational areas and the conversion of rangeland to cropland (NRC 2004). In addition, AREVA Enrichment Services, LLC has proposed the construction of the Eagle Rock Enrichment Facility. This facility would be located approximately 32 kilometers (20 miles) west of Idaho Falls, along U.S. Highway 20, approximately 2 kilometers (1 mile) to the east of INL.

3.2 Transportation

Regional Transportation Infrastructure

The ROI for the transportation infrastructure includes the INL on-site road systems, two U.S. highways, and a state route (Figure 3.2-1). U.S. Highways 20 and 26 are the main access routes to the southern portion of INL. State Route 33 provides access to the northern INL facilities. Table 3.2-1 provides average daily traffic data for selected segments of routes in the vicinity of INL. The daily weighted average of each route is the annual average daily traffic on the route. Each route is made up of segments that vary in distance and annual average daily traffic. The weighted average of each route is calculated by taking each segment of road from the beginning to the end (the total mileage of the segment) and dividing it by the total mileage of the total route.

Table 3.2-1: Annual Average Daily Traffic on Routes in the Vicinity of INL

Route	Daily Traffic Number of Vehicles weighted average
U.S. Highway 20 - Idaho Falls to INL	2800
U.S. Highway 26 - Blackfoot to INL	2400
State Route 33 - West from Mud Lake	600

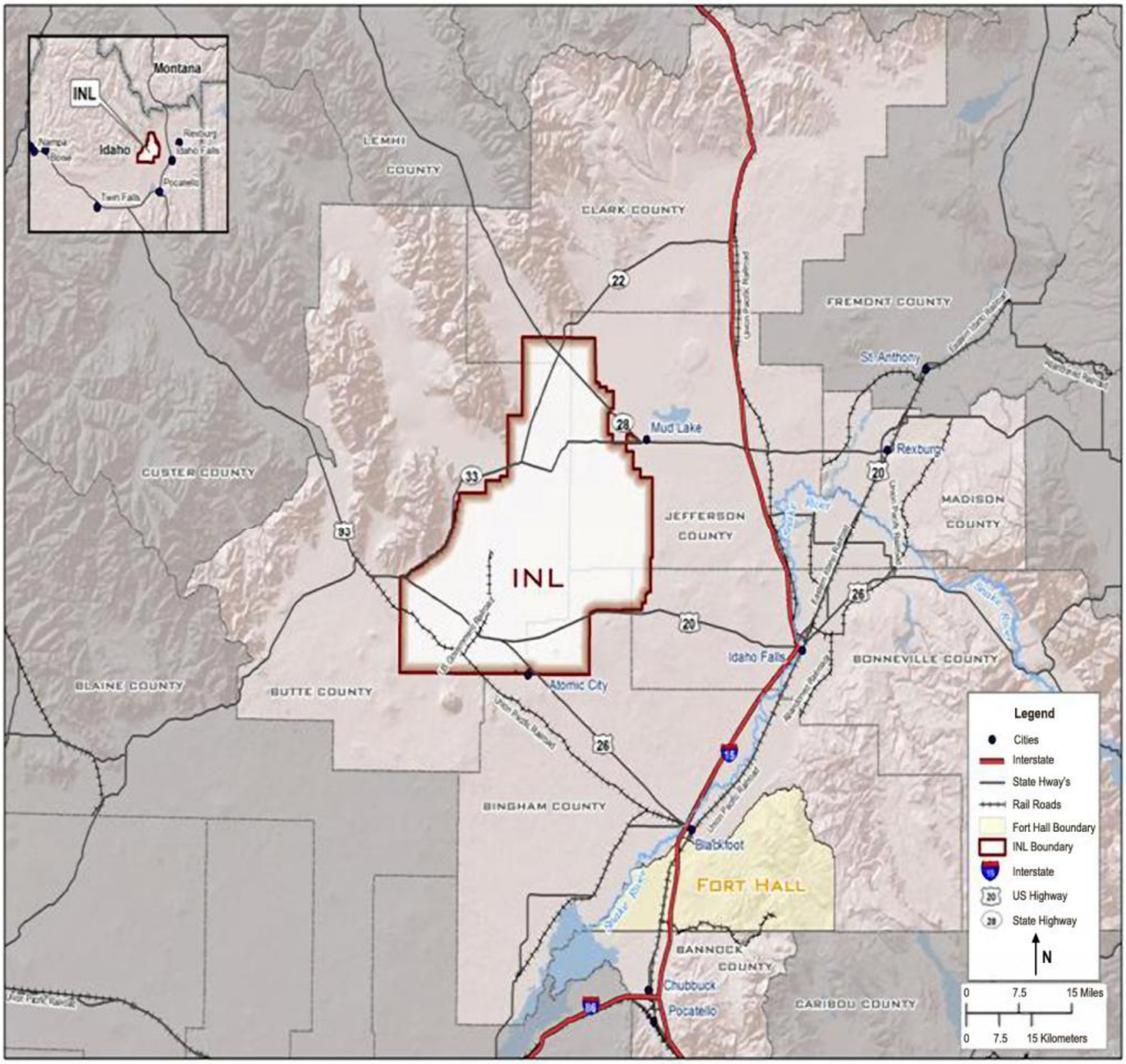


Figure 3.2-1: Regional Roadway Infrastructure in Southeastern Idaho

INL Transportation Infrastructure

INL contains an on-site road system of approximately 274 kilometers (170 miles) of paved roads. Some of the paved roads are highways that pass through INL and are used by the public; however, security personnel and fences strictly control public access to facilities at INL. Buses are available to transport workers to and from all site facilities located within the INL boundary.

INL contains an on-site railroad system of approximately 35 kilometers (22 miles) of rail. Union Pacific Railroad's main line to the Pacific Northwest follows the Snake River across southern Idaho. This line handles as many as 30 trains per day. Union Pacific Railroad provides service to INL from Blackfoot into the southern portion of INL where it terminates. This branch connects with a

DOE-owned spur line and then links with developed areas within INL (Figure 3.2-1). Rail shipments to and from INL are usually limited to bulk commodities, naval spent nuclear fuel, and radioactive waste.

Average Shipments From NRF

Resource Conservation and Recovery Act (RCRA) hazardous waste (including non-radioactive Toxic Substances Control Act (TSCA) waste), recyclable material, low level waste (LLW), mixed low level waste (MLLW), and radioactive TSCA wastes are transported from NRF. Table 3.2-2 summarizes the average annual NRF waste shipments from 2005 to 2009. RCRA hazardous waste, radioactive TSCA waste, and MLLW are shipped once a month, while routine solid LLW is shipped 38 times on average per year.

Table 3.2-2: Average Annual Waste Shipments From NRF

	RCRA Hazardous Waste	Non-Hazardous Waste	Recyclable Material	MLLW	Solid LLW	Radioactive TSCA Waste
Number of Shipments	12	52	12	12	38	12
Shipped To	Off-site Facilities	INL Central Facilities Area (CFA) Landfill Complex	Off-site Facilities	Off-site Facilities	Radioactive Waste Management Complex (RWMC) / Off-site Facilities	Off-site Facilities

Naval spent nuclear fuel is also shipped to INL. SA 1995 and SAA 2008 limit the annual number of shipments of naval spent nuclear fuel to INL (3-year running average) to 20 shipments (each shipping container is considered a shipment). NRF is in compliance with this limit; 16 total shipments of naval spent nuclear fuel were made between 2008 and 2010, for an average of less than 6 shipments per year.

The frequency of material shipments necessary to support NRF operations ranges from approximately one shipment a day to one shipment a week, depending on the amount of supplies ordered across NRF.

3.3 Geology and Soils

The ROI for the affected environment for geology and soils includes the INL and NRF. INL is located on the Eastern Snake River Plain (ESRP). The ESRP extends southwesterly from the northeast corner of Idaho, near Yellowstone National Park, toward the Hagerman-Twin Falls area.

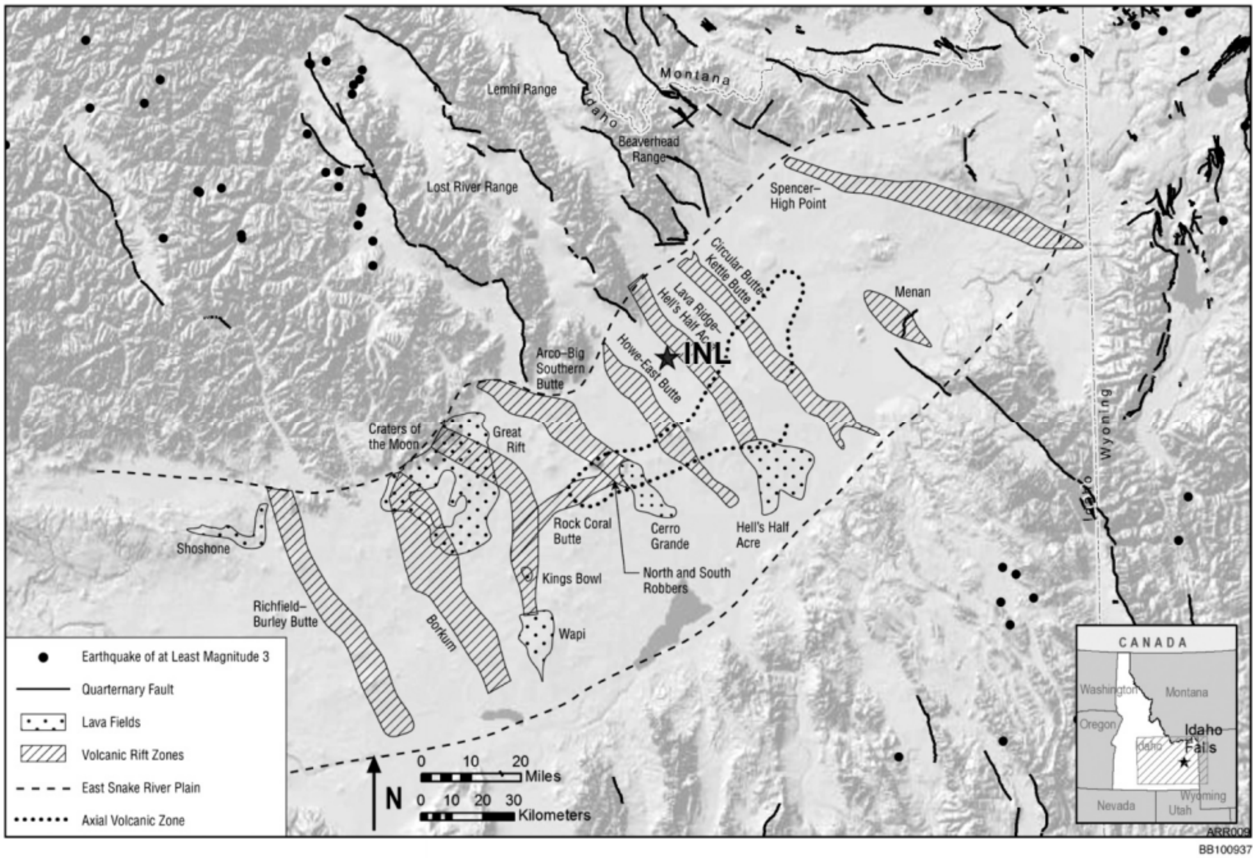
The INL is relatively flat, with vegetation typical of a sagebrush steppe, a plant community that is characteristic of cold desert ecosystems. Predominant relief includes volcanic buttes jutting from the desert floor, uneven surfaced basalt flows, and flow vents and fissures. INL has an average elevation of 1500 meters (4900 feet) above sea level and is bordered on the north and west by mountain ranges and on the south by volcanic buttes and open plain. (ESER 2010)

3.3.1 Geology

Regional Geology

INL is situated on a relatively flat area along the northwestern edge of the ESRP, within the ESRP Physiographic Province. The ESRP is a broad northeast-trending basin that continues to fill in with sediments and volcanic deposits. The ESRP was built up from multiple eruptions of basaltic lava between 4 million and 2100 years ago (DOE 2011c). Most of the visible ESRP was shaped during the last 1.2 million years by volcanic eruptions that resulted in basalt lava flows, domes, and steep-sided volcanic features. Overlying the basalts are thin, discontinuous deposits of wind-blown sand (loess composed of calcareous silt), floodplain sediments, and riverbed and lake sediments (clays, silts, sands, and gravels). Other sedimentary deposits are interbedded between the basalt flows and represent lulls in volcanic activity. To the northeast, the ESRP merges with the Yellowstone Plateau. Higher-elevation mountains and valleys of the geologic Basin and Range Province bound the ESRP to the north and south (NRC 2004). These mountains consist of folded and faulted rocks that are more than 70 million years old. This Basin and Range deformation, which began approximately 17 million years ago, affects some ongoing volcanic and tectonic processes in the INL area (BMPC 2011).

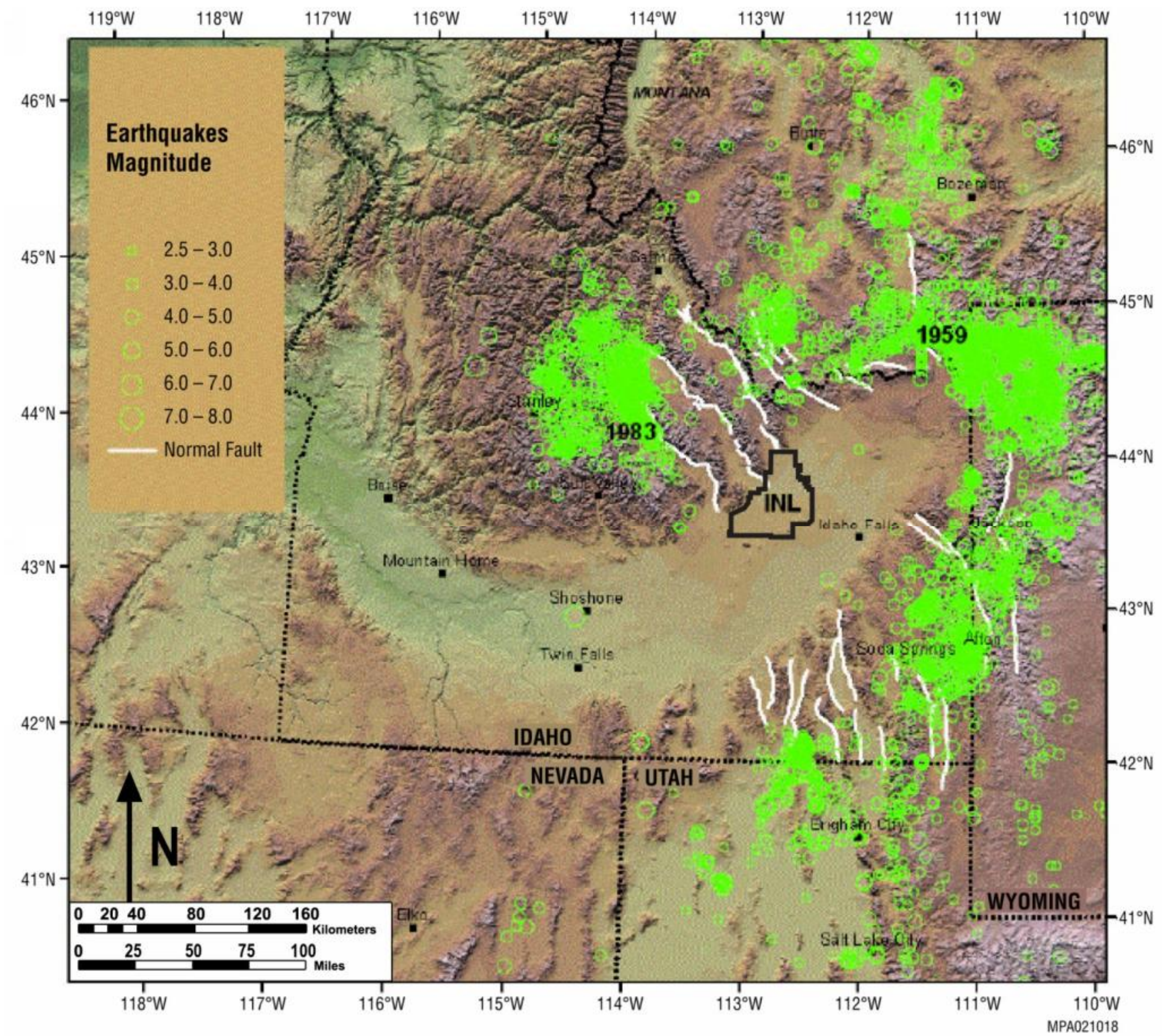
The tectonic forces from the movement of the North American tectonic plate controlled nearby Quaternary Basin and Range Province faulting (fracturing of the earth's crust with a component of vertical displacement) and likely affected the development of northwest-trending volcanic zones that cross the ESRP. Along with a northeast-trending zone that runs along the axis of the ESRP, these zones are associated with localized Quaternary volcanism that occurred during the last 1.2 million years. Most of this volcanism has consisted of thin basaltic lava flows from small fissures and small volcanic vents. Some past eruptions of rhyolite (silica-rich volcanics) have been more energetic and produced ash deposits and domes. The last of these rhyolite eruptions occurred about 300,000 years ago (NRC 2004). Volcanic activity occurred as recent as 2000 years ago to the west in the Great Rift Zone. Figure 3.3-1 shows the locations of the faults, volcanic rift zones, lava flows, and earthquakes with a magnitude greater than three (NRC 2011).



Source: NRC 2011

Figure 3.3-1: Locations of Volcanic Rift Zones and Lava Flows

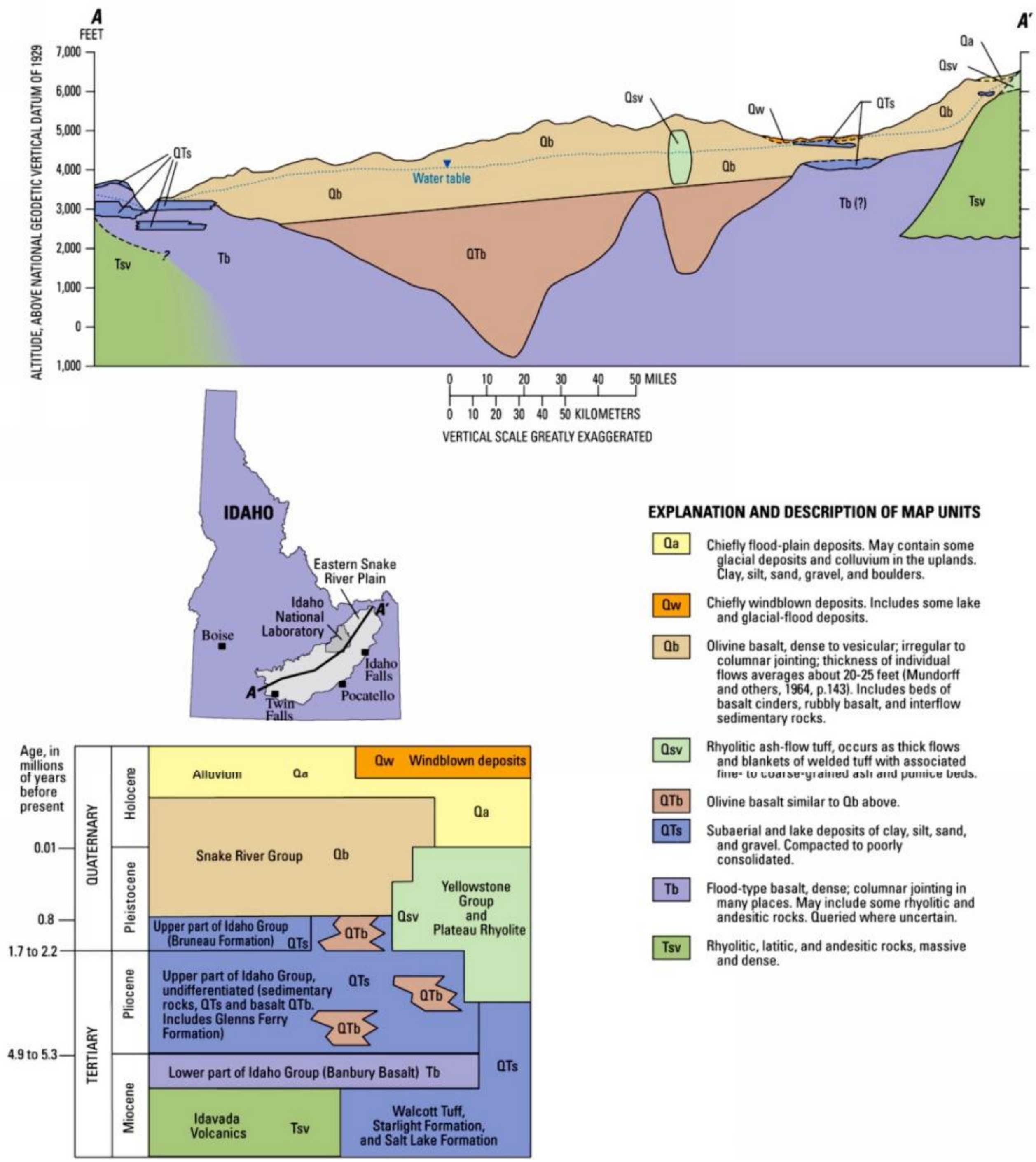
Approximately 2000 meters (6500 feet) of basalt layers interbedded with ancient stream and lake bed sediments are present in the ESRP. These beds have been modeled under INL and appear to dampen or attenuate shock waves generated by earthquakes. Over the past 100 years, there have been numerous earthquakes with a magnitude of 5.5 or greater with epicenters ranging from 93 kilometers (58 miles) to 283 kilometers (176 miles) from NRF. For an indication of the location and frequency of earthquakes, refer to Figure 3.3-2. The Hebgen Lake earthquake, the largest recorded earthquake in the vicinity of NRF, with a moment magnitude (measure of the energy released) of 7.3 hit the west flank of the Madison Range, 187 kilometers (116 miles) northeast of NRF in August of 1959. The facilities at INL were shaken but not damaged (BMPC 2011). On October 28, 1983, an earthquake hit the west side of the Lost River Range with a moment magnitude of 6.9 (DOE 1995). This earthquake was 93 kilometers (58 miles) west of NRF; again, the disturbance was felt at NRF without causing any damage (BMPC 2011).



Source: DOE 2011c

Figure 3.3-2: Location and Frequency of Earthquakes

The geologic formations underlying the ESRP are generalized in a cross-section and as a stratigraphic column in Figure 3.3-3. Quaternary alluvium, mainly resulting from floodplain processes, and Quaternary windblown deposits are found at the surface in the northwest area of the ESRP. The Quaternary Snake River Group is composed of slightly consolidated sedimentary deposits of thicknesses greater than 60 meters (197 feet) and is interbedded with basalts that are 5 to 25 meters (16 to 82 feet) in thickness. The Snake River Group generally is found throughout the ESRP area. Below the Snake River Group, in the northeast and southeast area of the ESRP, lies the upper part of the Idaho Group, which is Tertiary in age and consists of basalts and poorly consolidated sediment beds. The Quaternary Yellowstone Group and Plateau Rhyolite, which is composed of rhyolite ash-flow tuff, ash and pumice beds, is found in some areas of the ESRP. The lower part of the Idaho Group (Tertiary) is composed of basalt exhibiting columnar jointing and is fairly ubiquitous throughout the entire Snake River Plain. The Idavada Volcanics, Tertiary, are found in the Snake River Plain in the northeast and southwest areas (NRC 2011).



Source: NRC 2011

Figure 3.3-3: Regional Geologic Formations

Site Geology

Much information has been gathered about INL local geology from several geotechnical, remediation, and groundwater investigations where numerous wells and boreholes were drilled and logged over the last 60 years. Figure 3.3-4 generalizes the rock units beneath INL.

The NRF and immediately surrounding site geology, as described in the following paragraphs, is summarized from WEC 1997a. Two types of surficial sedimentary deposits are found at NRF. There is a wind-blown deposit, loess, that has a primary constituent of montmorillonite clay and when present varies in thickness from several centimeters to a few meters (approximately a couple of inches to 10 feet). Generally this deposit, sometimes associated with fine-grained sands, overlies gravel deposits that are thought to be fluvial in origin. The gravel layer includes sedimentary, metamorphic, and igneous rocks that are thought to have originated from the mountains north and west of INL and is sometimes interbedded with silt and clay.

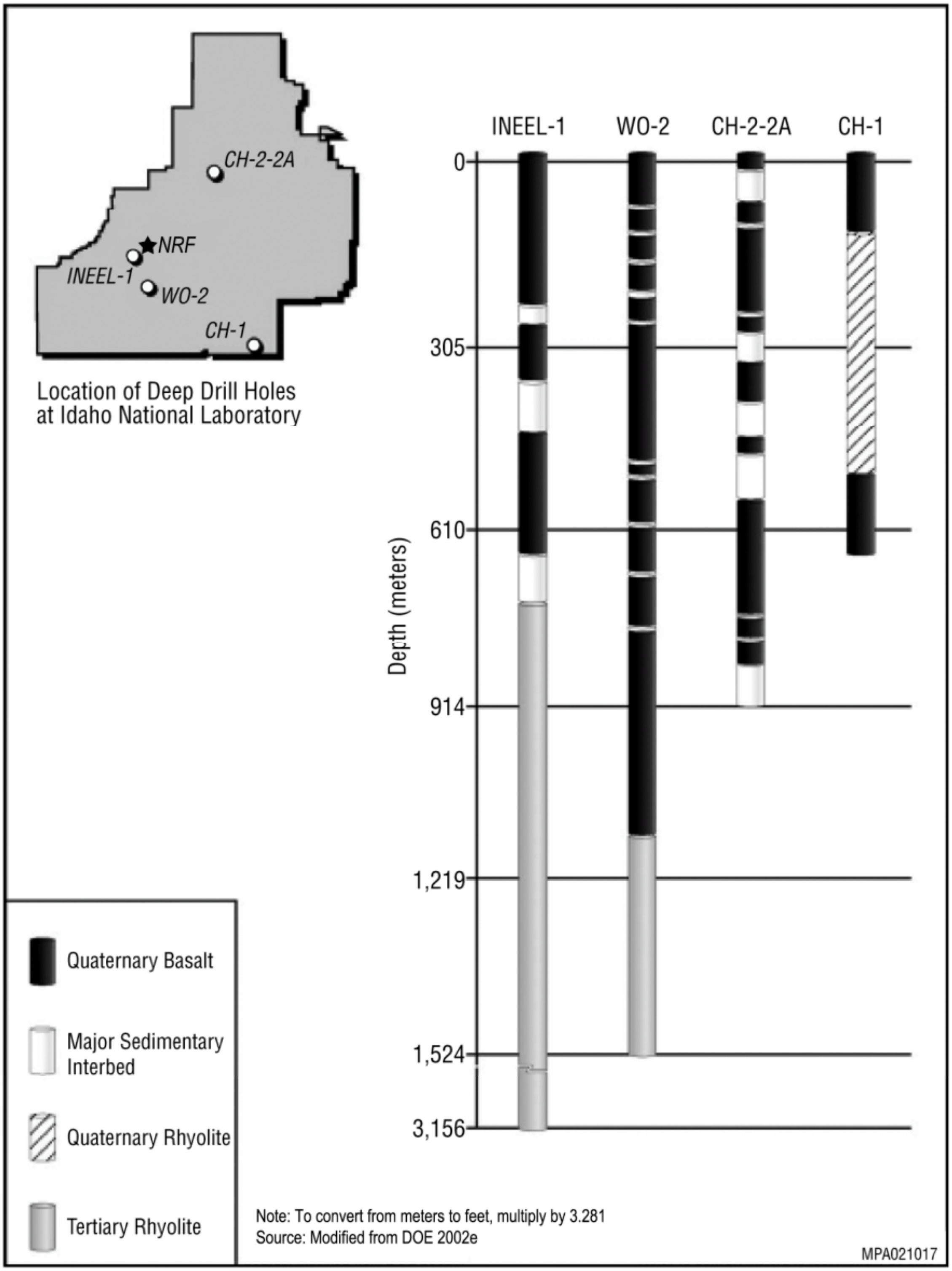
Many of the basalt flows at NRF are separated by sedimentary layers or interbeds. Four major interbeds have been identified. The first major interbed ranges in thickness from approximately 15 centimeters to over 4.25 meters (6 inches to over 14 feet). It is classified as a lithic wacke, a rock unit composed of poorly sorted mixtures of basalt and quartz grain rock fragments with a high clay content. Much information has been gathered on this interbed from numerous boreholes and geophysical logs. The top of this unit has been identified and mapped because perched water may be associated with this layer. Because of its wide-range occurrence and physical properties, it has the potential to impede contaminant migration.

Basalt, underlying the alluvium, is approximately 460 to 610 meters (1500 to 2000 feet) in thickness. Depth from the surface to the top of basalt ranges from 0 to 18 meters (0 to 60 feet), and is typically found at a depth of approximately 9 meters (30 feet). The basalt consists of individual flows ranging in thicknesses of approximately 1.5 to 21 meters (5 to 70 feet). Most of the fractures in the basalt most likely resulted from the cooling process and would be confined to specific flows and not transecting across other flows of other ages. Other fractures may have been a result of local or regional stresses, but no data were gathered to support this hypothesis (WEC 1997a).

Geologic Natural Resources

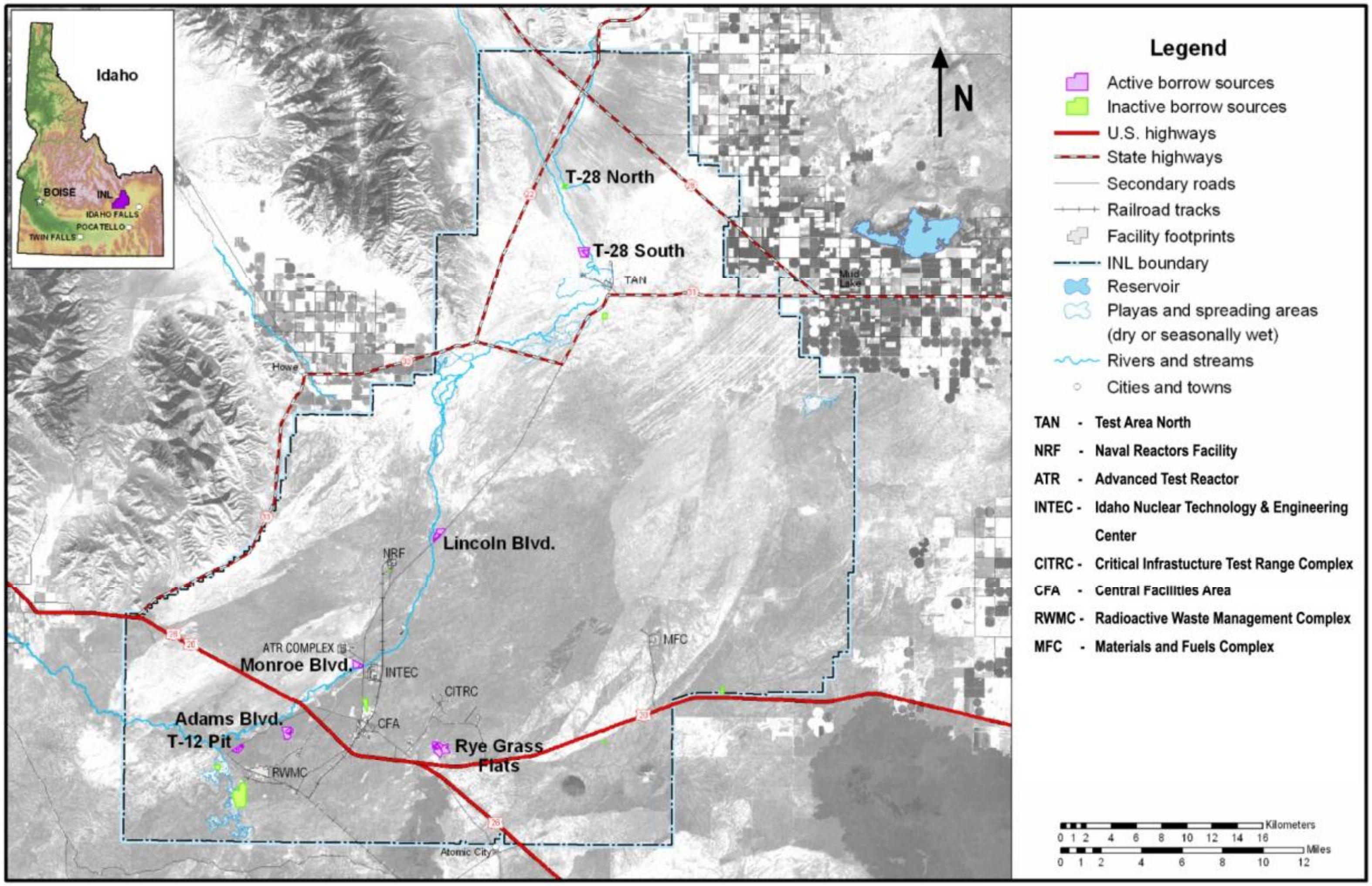
Mineral resources that are inside the INL boundary are limited to several quarries, or borrow sources, that supply sand, gravel, pumice, silt, clay, and aggregate for road construction and maintenance; new facility construction and maintenance; waste burial activities; and ornamental landscaping cinders used on-site. On-site topsoil is a very limited commodity. Historically, INL has been a source of borrow materials that were used on-site. Many abandoned pits and excavations are found adjacent to roads and near older structures and facilities throughout the site. Currently, six borrow sources are in use on INL, and one inactive source has a high potential as a source material if production were resumed.

Figure 3.3-5 shows the location of the borrow sources, and Table 3.3-1 provides a description of these resources (Bean and Jolley 2009).



Source: DOE 2011c

Figure 3.3-4: Logs of Rock Units by Drill Holes



Source: Bean and Jolley 2009

Figure 3.3-5: INL Borrow Sources

Table 3.3-1: INL Borrow Sources

Borrow Source and Type	Approved Footprint		Current Excavation		Original Volume		Volume Removed		Volume Remaining	
	hectares	acres	hectares	acres	cubic meters (millions)	cubic yards (millions)	cubic meters (millions)	cubic yards (millions)	cubic meters (millions)	Cubic yards (millions)
Rye Grass Flats Silt/Clay	103	253	14	35	1.6	2.0	0.2	0.3	1.4	1.7
T-12 (nearly depleted) Sand and Gravel	30	75	19	47	1.2	1.5	0.7	0.9	0.5	0.6
Monroe Boulevard Sand and Gravel	33	80	9	21	2.8	3.7	0.7	1.0	2.1	2.7
Adams Boulevard Sand and Gravel	61	150	15	38	1.8	2.4	0.5	0.6	1.3	1.8
Lincoln Boulevard Sand, Gravel, and Topsoil	42	105	12	30	3.0	3.9	0.9	1.1	2.1 (0.3 topsoil)	2.8 (0.4 topsoil)
T-28 South Sand and Gravel	55	136	17	43	2.4	3.1	0.7	1.0	1.7	2.1
T-28 North (inactive) Gravel	9	21	6	14	0.4	0.5	0.2	0.3	0.2	0.2

Source: Bean and Jolley 2009

Note: Average depth of the borrow sources varies between 2 to 9 meters (6 to 28 feet).

Outside of INL and within approximately 160 kilometers (100 miles) of the boundary, mineral resources include sand, gravel, pumice, phosphate, and base and precious metals. The geologic history of the ESRP makes the potential for petroleum production at INL very low (NRC 2004). However, there has been interest in petroleum exploration in the Tertiary basin sediments in the far western portion of the Snake River Plain. A 13-megawatt geothermal plant, the Raft River Site, is located approximately 320 kilometers (200 miles) southeast of Boise (NRC 2011). Geothermal energy is being further explored in Idaho.

3.3.2 Soils

Figure 3.3-6 shows general soil types at INL. Soil at NRF is characterized as coarse deposits of cut terraces with an average soil depth of greater than 6.1 meters (20 feet).

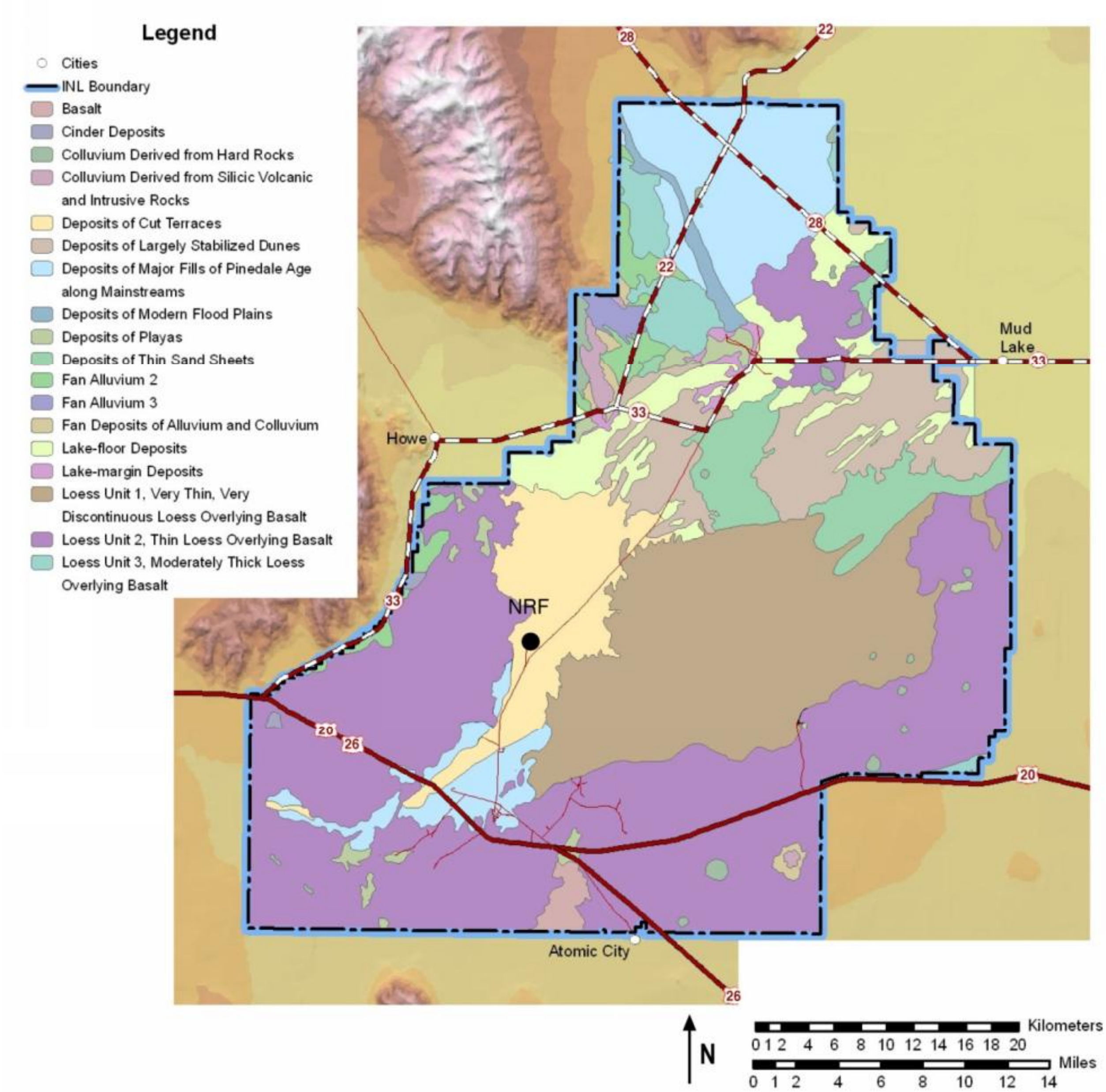


Figure 3.3-6: Soil Types at INL

Figure 3.3-7 shows the areas of INL where the soil depth is greater than 6.1 meters (20 feet).

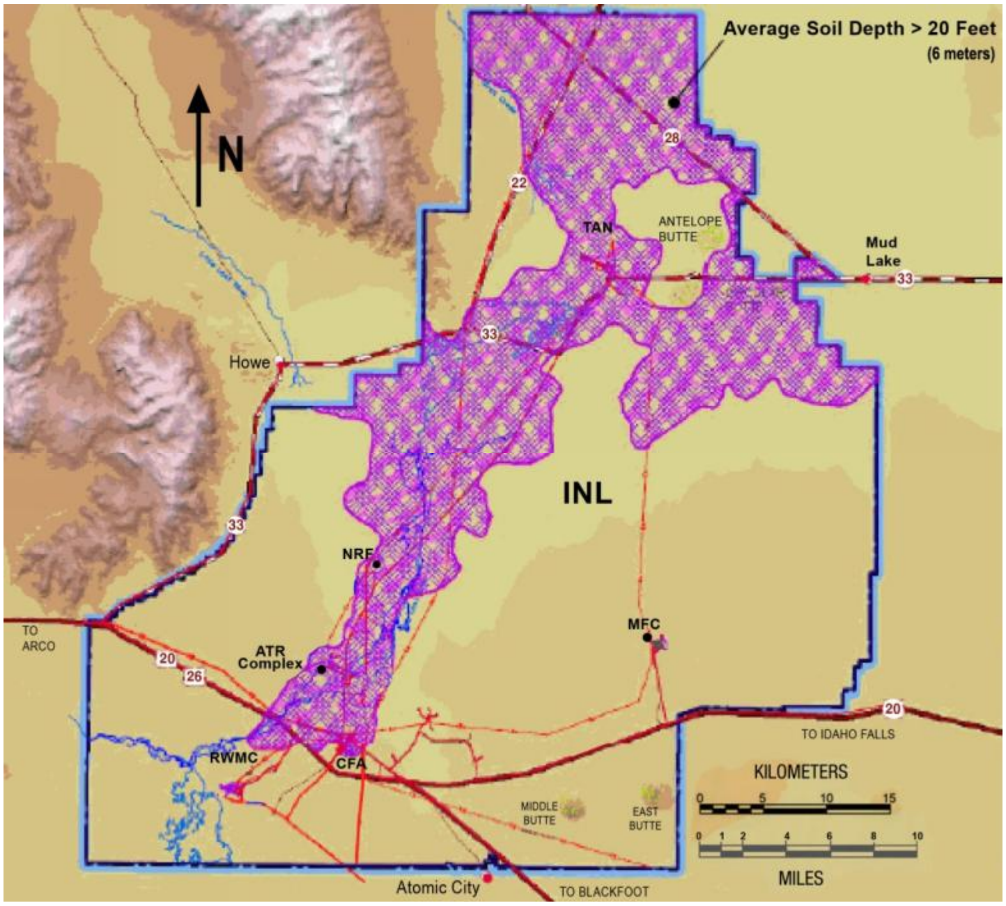
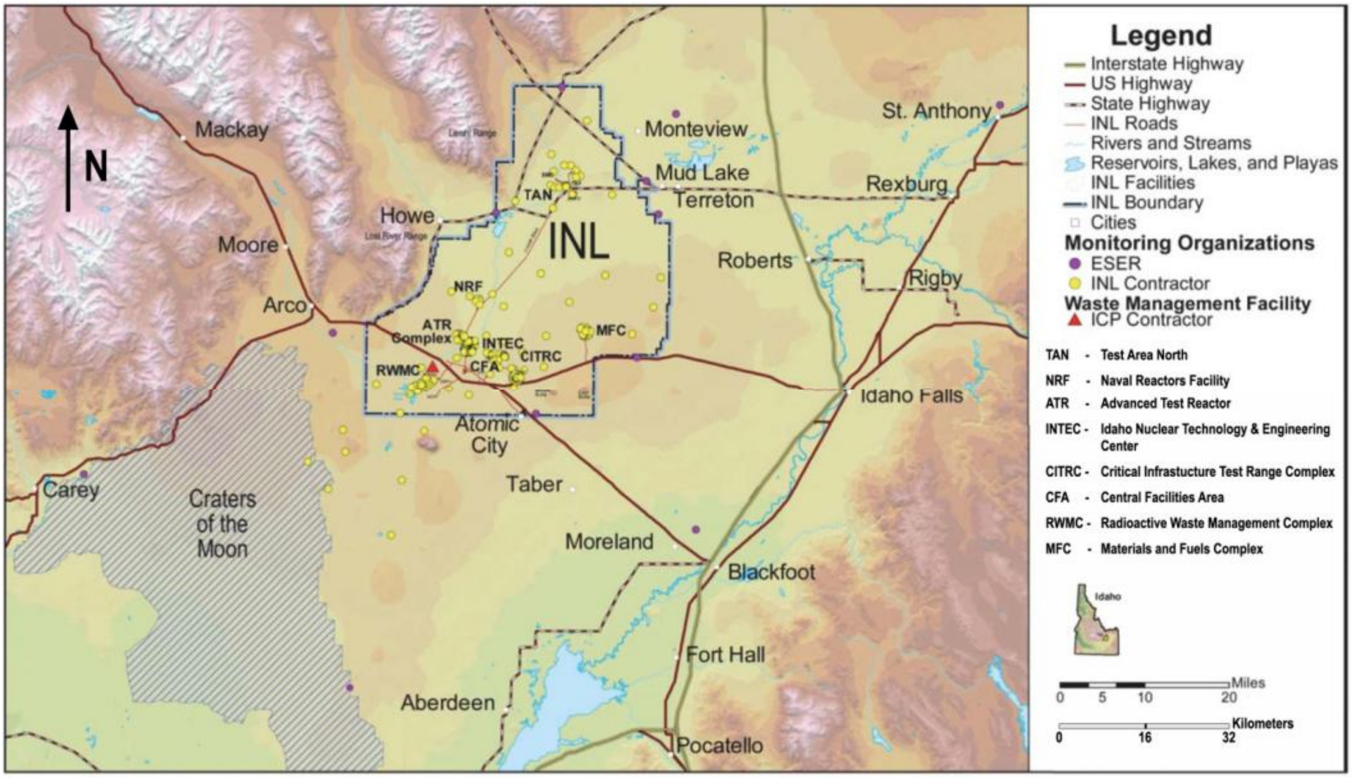


Figure 3.3-7: Soil Depth at INL

Radiological Characteristics

For INL, it is appropriate to consider specific areas that have been historically contaminated with radionuclides above background levels. Most of these areas have been monitored for radionuclides in soil since the early 1970s. Figure 3.3-8 shows the regional soil monitoring locations. In some of these areas, structures have been removed and areas cleaned to a prescribed, safe level; but the soil may still have residual measurable concentrations of radionuclides.



Source: ESER 2011

Figure 3.3-8: Regional Soil Monitoring Locations

INL was listed on the National Priorities List (NPL) for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 1989. While the evaluation concluded that NRF itself did not warrant inclusion in the NPL, the combined ranking with other INL facilities resulted in placement of the entire INL on the NPL. In accordance with CERCLA requirements, the EPA, state of Idaho and DOE negotiated a Federal Facility Agreement and Consent Order which describes how CERCLA activities would be accomplished on INL. To manage CERCLA sites Waste Area Groups (WAGs) were formed; NRF is in WAG 8 (Figure 3.4-11).

At NRF, there are isolated areas where controlled releases of low-level radioactive liquids were made prior to 1979. These areas were included in remedial actions as determined by the Comprehensive Remedial Investigation and Feasibility Study and agreed to by the state of Idaho and the EPA in the Record of Decision (ROD) signed in September 1998 (IDEQ 1998). These remedial actions were completed in 2004. This ROD also identified 12 No Further Action sites. These are sites where contamination above risk-based levels could be present, but for which an exposure route is not available under current conditions; therefore, they are not yet releasable for unrestricted use, and thus designated as Institutional Controls required. The No Further Action sites are required to be included in the CERCLA review performed at least every 5 years to ensure that conditions have not changed; no remedial action is required for these sites. The most recent NRF Five-Year Review concluded that the remedy for the No Further Action sites has been effective in limiting unauthorized access and excavation. In addition, the most recent NRF Five-Year Review identified four sites released from CERCLA institutional controls because they are no longer necessary (NNPP 2012).

The total radioactivity released to the soil over the operational life of NRF is equal to the amount of naturally occurring radioactivity in the top 61 centimeters (24 inches) of native east central Idaho soil covering a local area of equal size to NRF. Members of the public cannot come in direct contact with any of the small amounts of residual radioactivity still present at NRF. Table 3.3-2 includes the most recently measured concentrations of radionuclides in soil at NRF measured as part of the INL monitoring program. Although the concentrations of radionuclides in Table 3.3-2 are considered representative of NRF soil, higher concentrations have been measured in isolated locations at NRF (e.g., in CERCLA areas).

Table 3.3-2: Concentrations of Radionuclides in NRF Soil

Radionuclide	Detected Concentration	
	Minimum	Maximum
	picocuries per gram	
^{137}Cs[1]	1.0×10^{-2}	1.2
$^{239}Pu/^{240}Pu$[2]	5.70×10^{-3}	1.60×10^{-2}
^{241}Am[2]	4.30×10^{-3}	9.70×10^{-3}
[1]Source: BMPC 2010 [2]Source: ESER 2010		

Radionuclides in soils may be incorporated into agricultural products which are then consumed by game animals. Therefore, the INL collects soil data for the INL facility areas (Table 3.3-2 provides the data collected for NRF) to support a screening analysis for potential dose to terrestrial biota. The results of this screening analysis show there is no evidence that INL site-related radioactivity in soil is harming terrestrial plant or animal populations (ESER 2010).

Chemical Characteristics

The CERCLA evaluation included chemical characteristics as well as radiological characteristics. At NRF, various areas were evaluated for chemical contaminants by soil gas analysis, soil samples, and historical information. Three historical landfill sites on the NRF were found to have contents similar to those found in municipal landfills including volatile organic compounds (VOCs). INEL 1994 selected containment with a native soil cover for these areas. Actions specified included surveying and marking the areas, restricting land use by means of administrative controls, monitoring soil gases, and installation and maintenance of a native soil cover over the landfill contents. Five-year reviews have been conducted and have verified that the actions taken remain protective of human health and the environment. Annual soil-gas monitoring of the three NRF inactive landfills show that the landfills that contain low levels of VOCs from past operations continue to be adequately controlled and contained to minimize migration of those contaminants. The levels of VOCs present in the subsurface at the three landfills do not present any significant risk to NRF personnel, the general public, or the environment. The results of soil gas monitoring are reported in BMPC 2014. BMPC 2014 concludes that the soil gas emissions surveys verify that the landfill soil covers for all three landfills are effective in limiting surface soil gas emissions to the environment.

3.3.3 Geologic Hazards

Seismic Hazard

The faults closest to INL facilities are the Quaternary Lost River, Lemhi, and Beaverhead faults. They are normal faults (type of fault associated with Basin and Range tectonics) located along the base of the mountains to the west and north of INL. Most earthquakes with the potential to affect INL occur along normal faults in the Basin and Range province north of the Snake River Plain (INL 2010a). The faults and locations of the earthquakes are shown on Figures 3.3-1 and 3.3-2.

In 2000, INL completed a site-specific probabilistic seismic hazards assessment for all facility areas at INL. The purpose of this assessment was to estimate the levels of ground shaking that can be expected at INL facilities from all earthquake sources in the region. This seismic hazards assessment considered and incorporated results of geologic, seismologic, and geophysical investigations. The following were used as input parameters for the seismic hazard model:

- Types of faulting, earthquake magnitudes, and recurrence rates for fault-specific, volcanic, Snake River Plain, and Basin and Range earthquake sources
- Crustal attenuation models that predict the manner in which seismic waves dissipate as they travel through the subsurface in the ESRP and surrounding mountains
- Propagation characteristics of seismic waves through site-specific subsurface geologic conditions, such as the alternating basalt and sediment layers beneath INL (INL 2010a)

Sensitivity analyses of these input parameters were performed to determine the important contributors to the seismic hazard and to assess the uncertainties in the hazard. The final probabilistic ground motion estimates are in the form of the levels of ground shaking that are expected to occur once in specified time periods (frequency), such as 1000, 2500, and 10,000 years. The estimates were completed for surface rock conditions at all INL facilities in 1996 and updated in 2000 (INL 2010a). INL continues to collect site-specific seismic data by operating 32 seismic stations located on-site (one located at NRF), and on and around the Snake River Plain. Data are also collected from the 15 Global Positioning System stations that measure the deformation of the earth's crust and from 32 strong-motion accelerographs (four located at NRF) that, in the event of an earthquake, would measure ground shaking and a building's response to the shaking.

Probabilistic Seismic Hazard Analysis (PSHA) provides a means to determine the effect of a design basis earthquake on infrastructure and equipment to provide a basis to be used in structural evaluations to ensure that infrastructure and equipment perform their safety functions under the effect of earthquakes. The most recent PSHA for the INL, which included NRF, was completed in 1996, and recomputed in 2000. The 2000 recomputation used the 1996 seismic source characterization models, but changed the site-specific and empirical ground motion models to ones that were more appropriate for the tectonic environment at the INL. The PSHA incorporates the region-specific seismic source characterization models including fault-specific sources, volcanic zones, area source zones, and random-earthquake sources. Ground motion models included both site-specific models for NRF subsurface conditions and available empirical models from other locations.

In 2011, a sensitivity analysis was performed for NRF and changes to ground motion models were evaluated using available data and currently accepted methods for modeling. Based on the 2011 sensitivity analysis, the authors of the analysis recommended that margin be added to ground motion models for future projects based on the potential for future changes to the 2000 PSHA. Additional sensitivity analysis performed in 2013 for NRF included evaluating fault source impacts to seismic hazard levels by isolating changes in ground motion models and seismic source characterization. The 2013 sensitivity analysis for NRF showed that changes to area source models and site-specific and empirical ground motion models resulted in similar ground motion levels to the 2011 NRF and 2000 INL seismic hazard analyses.

In 2015, a Senior Seismic Hazard Analysis Committee (SSHAC) Level-1 seismic review was conducted on the site (INL 2016). Using current ground motion models, the INL 2016 review indicated that the additional margin suggested by the authors of the 2011 NRF seismic sensitivity study would not be necessary for future projects. The INL 2016 review also validated that the ground motion levels for the 2011 NRF seismic sensitivity study and the 2000 PSHA are similar.

Volcanic Hazards

The potential for future volcanism and associated volcanic hazards at INL are a consequence of the volcanic history of the ESRP. Eruptions of silica- and iron-rich (mafic) magmas have occurred in the ESRP as a result of the Yellowstone hotspot in conjunction with crustal thinning associated with Basin and Range extension of the crust. Explosive silica-rich, caldera-forming eruptions began approximately 16 million years ago, in association with the hotspot's initial position centered on the common borders of Idaho, Oregon, and Nevada. The hotspot is now located beneath the Yellowstone Plateau, which has had three major caldera eruptions over the last 2 million years. After passage of the hotspot in the area of the INL, mild effusive eruptions of iron-rich magmas that result from relatively recent basaltic volcanoes and rift zones are typical in the ESRP. Volcanic activity on the ESRP dates from 4 million years ago to as recently as 2100 years ago (DOE 2011a). The most recent eruptions produced basalt lava flows 2100 to 15,000 years ago at Craters of the Moon National Monument in the Great Rift volcanic rift zone (INL 2010a).

Volcanic hazards at INL have been evaluated for possible hazard phenomena associated with the different types of silica- and iron-rich eruptions. Hazards associated with explosive, silica-rich caldera-forming eruptions, similar to those that have occurred at the Yellowstone Plateau, are considered to be negligible for INL. Volcanic ash-falls could occur at INL from eruptions as far away as the Cascade Mountains. A 10^{-3} annual probability was calculated for a 1.0-centimeter (0.4-inch) thick ash deposit forming at INL from a Cascade volcano eruption (NRC 2004). Rhyolite dome volcanoes, such as Big Southern Butte or East Butte, also have the potential to produce ash-fall deposits. In addition, large volume eruptions from the Yellowstone Volcanic Zone could produce appreciable ash-fall deposits at INL, in the unlikely event that regional winds were directed to the southwest during a potential eruption. Basaltic volcanism has occurred as recently as 2100 years ago in the Great Rift, southwest of INL. Other basaltic lava flows near the southern INL boundary erupted about 5000 and 13,000 years ago (INL 2010a). Based on the probability analysis of the volcanic history in the Big Southern Butte area, the conditional probability that the south-central INL would be affected by basaltic volcanism would be once in 40,000 years or longer. The estimated probability of volcanic impact is less than once every million years or longer for the northern INL because past volcanism was older and less frequent (DOE 1995).

3.4 Water Resources

The ROI for the affected environment for water resources includes INL and NRF surface waters where storm water, industrial wastewater, or sanitary wastewater are discharged (e.g., Industrial Waste Ditch (IWD) and active sewage lagoons), perched water zones and groundwater beneath NRF, and the Snake River Plain Aquifer (SRPA) beneath and downstream of INL. Regional drainage, floodplains, and off-site water quality are included in the affected environment description to establish a baseline for cumulative impacts.

This section describes INL surface and groundwater resources in general, and provides specific information regarding current levels of non-radiological and radiological contaminant concentrations in surface water effluent and groundwater due to operations at NRF. Wastewater, storm water, and flooding potential are discussed for NRF. General INL descriptions primarily rely on previous EISs (e.g., DOE 2005b), CERCLA 5-year review reports, and INL Environmental Monitoring Reports (e.g., ESER 2009 and ESER 2010). Facility specific information for NRF is from site-specific monitoring and hydrology reports (e.g., BMPC 2009a, BMPC 2009b, and WEC 1997a), CERCLA 5-year review reports, and permits.

The EPA has established, under authority of the Safe Drinking Water Act (SDWA), National Primary Drinking Water Regulations known as primary standards. Primary standards limit the levels of contaminants in drinking water. Maximum Contaminant Levels (MCLs), as contained in 40 C.F.R. § 141, are the highest levels of contaminants that are allowed in drinking water and are legally enforceable. National Secondary Drinking Water Regulations or secondary standards are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water (40 C.F.R. § 143). Idaho Administrative Procedures Act (IDAPA) 58.01.08 establishes State drinking water standards which are enforced by the Idaho Department of Environmental Quality (IDEQ).

The state of Idaho has established primary and secondary constituent standards for groundwater per IDAPA 58.01.11. These standards essentially mirror the federal primary and secondary standards established by EPA, and apply to any activity with the potential to substantially degrade groundwater (aquifer) quality. Unlike the federal secondary standards, state secondary constituent standards may be enforced.

In this document, MCL terminology is used when the subject matter refers to EPA drinking water and CERCLA. When the subject matter refers to state of Idaho groundwater, primary and secondary constituent standards terminology is used.

3.4.1 Surface Water Resources

3.4.1.1 Natural Water Features

INL

INL is in the Mud Lake - Lost River drainage basin. This is a closed basin that includes the Big Lost River, Little Lost River, and Birch Creek (Figure 3.4-1). IDEQ regulates protection of bodies of water in Idaho for existing or designated uses. Big Lost River, Little Lost River, and Birch Creek have been designated for cold water aquatic communities, salmonid spawning, and primary recreation (IDAPA 58.01.02). The Big Lost River channel and sinks and lowermost Birch Creek are classified for domestic water supply and as special resource waters. In general, the Big Lost River, Little Lost River, and Birch Creek are similar with respect to water quality. Chemical compositions reflect the carbonate mineral compositions of the mountain ranges drained by the streams and the quality of irrigation water return flows. None of the rivers or streams on or near INL have been classified as Wild and Scenic per the Wild and Scenic Rivers Act, 16 U.S.C. § 1274. Surface waters are not used for drinking water at INL, nor are effluents discharged directly to them; therefore, no surface water rights are issued to INL.

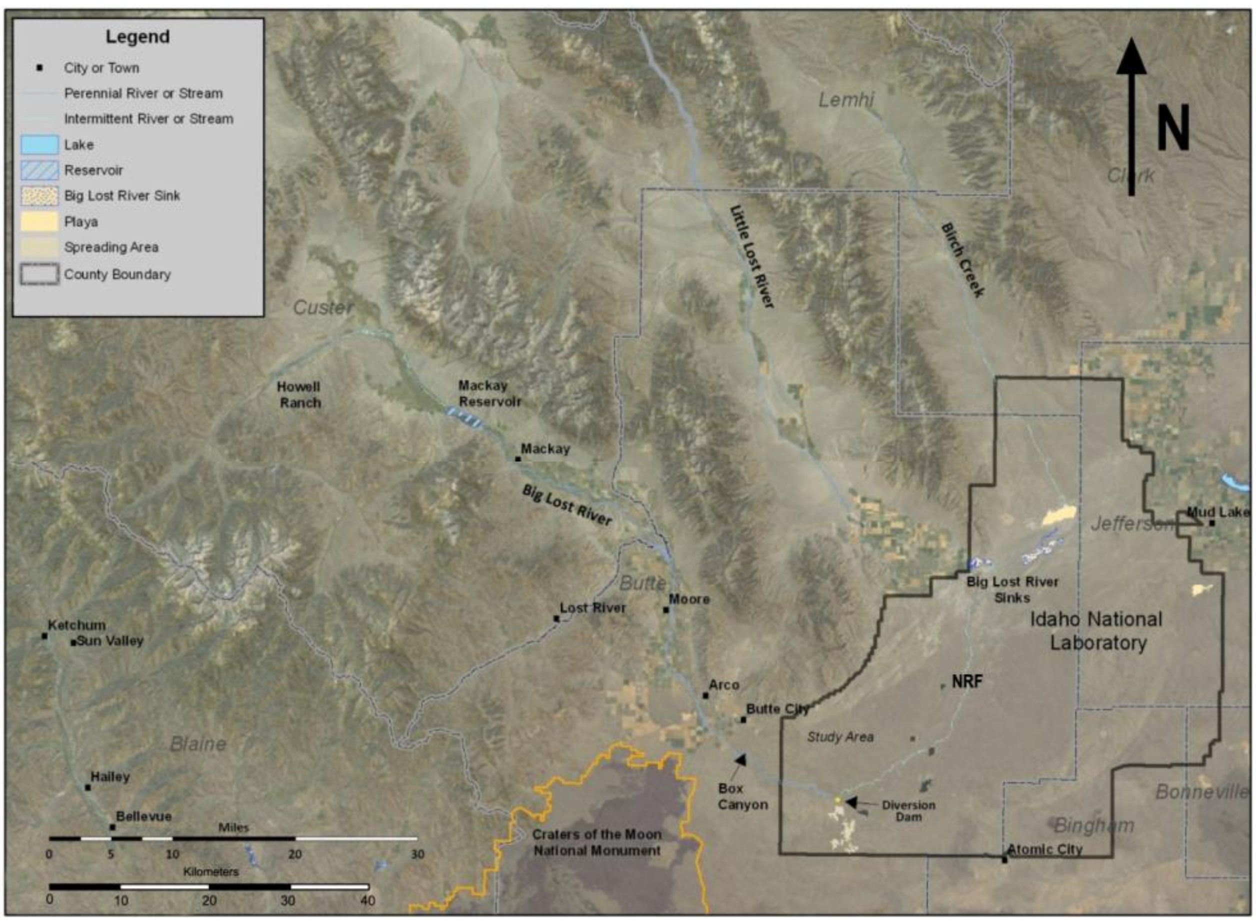


Figure 3.4-1: Mud Lake - Lost River Drainage Basin

The Big Lost River, Little Lost River, and Birch Creek are intermittent on INL. During the summer months, most flow from these streams is diverted for irrigation before it reaches INL boundaries.

During fall and winter, seasonal changes in climate (e.g., precipitation and temperature) reduce stream flow such that it does not generally reach INL. The Big Lost River, Little Lost River, and Birch Creek flow year-round off INL and drain the mountain areas to the north and west of the site. Flow that reaches INL seeps into the ground surface along the length of the streambeds and in the Big Lost River spreading areas (near the southwest boundary of the INL) and sinks (located 11 kilometers (7 miles) north and northeast of NRF) (Figure 3.4-2). The spreading areas are natural low elevation closed basins associated with the INL diversion dam. The sinks are the lowest elevation in the closed drainage basin where the Big Lost River terminates into a series of playas where seasonal wetlands have formed. Surface water on INL that does not infiltrate the ground surface is lost from the system through evapotranspiration processes. No surface water flows off INL.

The Big Lost River flows southeast from Mackay Dam, past Arco, and onto the Snake River Plain (Figure 3.4-1). The INL diversion dam, near the southwestern boundary, prevents flooding of downstream areas during periods of heavy runoff, by diverting water to a series of natural depressions or spreading areas (Figure 3.4-2). During periods of high flow or low irrigation demand, the Big Lost River continues to the northeast past the diversion dam, passes between the Idaho Nuclear Technology and Engineering Center (INTEC) and the Advanced Test Reactor (ATR) Complex, and ends in a series of playas about 11 kilometers (7 miles) north-northeast of NRF, where the water infiltrates the ground surface.

National Wetland Inventory maps prepared by the USFWS indicate wetland areas are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks (Figure 3.4-2). These wetlands are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. The only U.S. Army Corps of Engineers (USACOE) jurisdictional wetlands are the Big Lost River sinks.

NRF

The closest natural surface water to NRF is the Big Lost River. NRF is approximately 2.4 kilometers (1.5 miles) west of the Big Lost River. The Big Lost River has been dry for periods ranging from 6 months to 5 years or more. The Little Lost River flows towards INL from the north and sinks into the ground near the INL border 11.2 kilometers (7 miles) north of NRF.

Several natural abandoned meander channels are present on NRF (WEC 1997a). These channels vary in size from hardly noticeable to 3.6 meters (12 feet) wide by 1.8 meters (6 feet) deep. Several man-made irrigation canals also cross the property. Because water no longer flows in these channels and canals, they do not appreciably influence the hydrology of NRF (BBI 2006a).

The Big Lost River sinks are about 11.2 kilometers (7 miles) north-northeast of NRF (Figure 3.4-2).

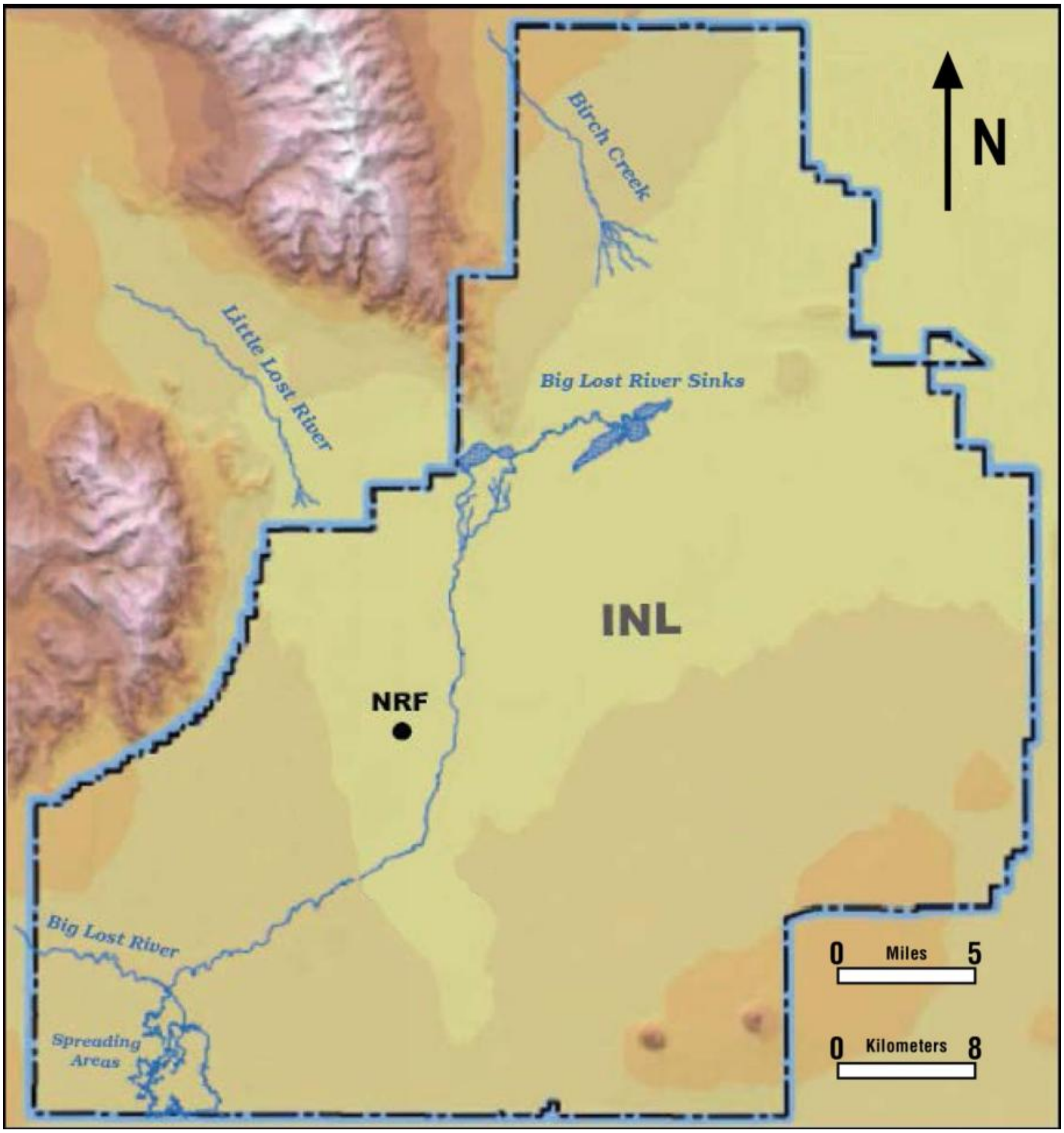


Figure 3.4-2: Natural Water Features on INL

3.4.1.2 Surface Water Quality

Surface water locations outside of the INL boundary were sampled for gross alpha activity, gross beta activity and tritium (^3H) in 2003 (DOE 2005b) and in 2010 (ESER 2011). In 2003, twelve surface water samples from five off-site locations were collected along the Snake River. One sample had a detectable gross alpha concentration of 1.53 picocuries per liter compared to the EPA MCL of 15 picocuries per liter. Nine of 12 samples had measurable gross beta activity, while only one sample had measurable ^3H. Detectable gross beta activity levels from these samples ranged from 3.1 to 8.0 picocuries per liter, as compared to the EPA screening level of 50 picocuries per liter. Concentrations in this range are consistent with those measured prior to 2003 and cannot be differentiated from natural decay products of thorium and uranium that dissolve into water as the water passes through the surrounding basalts of the ESRP. The sample with ^3H had a concentration of 94.7 picocuries per liter, as compared to the EPA MCL for drinking water of 20,000 picocuries per liter.

In 2010, surface water was sampled at three springs downgradient of INL and at four locations along the Big Lost River (ESER 2011). The downgradient springs were located near Twin Falls (Alpheus Springs), Buhl (Clear Springs), and Hagerman (Bill Jones Hatchery). Gross alpha concentrations below the EPA MCL were detected at Alpheus Springs (1.12 (± 0.33) picocuries per liter) and Clear Springs (2.08 (± 0.56) picocuries per liter), but no activity was detected at the hatchery. Gross beta activity levels ranged from 3.61 (± 0.47) picocuries per liter at the hatchery to 8.31 (± 0.26) picocuries per liter at Alpheus Springs and are attributed to natural decay products. ^3H was not detected in any of the spring samples analyzed by the Environmental Surveillance, Education, and Research (ESER) contractor. All results were corroborated by co-sampling performed by IDEQ, except that very low levels of ^3H (< 50 picocuries per liter) were detected in two of their samples.

Sample locations along the Big Lost River were at the public rest stop on U.S. Highway 20/26; along Lincoln Boulevard near INTEC and near NRF; and at the INL Experimental Field Station. Gross alpha and beta activity were detected at low levels at all of the sample locations (gross alpha range: 1.12-1.71 picocuries per liter; gross beta range: 0.90 to 2.18 picocuries per liter). ^3H was detected at low levels at all of the Big Lost River sample locations except for near INTEC. Concentrations ranged from 114 to 163 picocuries per liter, well below the MCL.

3.4.1.3 Wastewater

Other surface water bodies on INL include man-made percolation and evaporation ponds, sewage lagoons, and industrial waste ditches. These ponds, lagoons, and ditches are used for wastewater management at INL and include the INTEC New Percolation Ponds, Test Area North/Technical Support Facility Sewage Treatment Plant Disposal Pond, ATR Complex Cold Waste Pond, Materials and Fuels Complex (MFC) Industrial Waste Pond and ditch, MFC Sanitary Lagoons, and the NRF IWD. NRF also has sewage lagoons.

INL Wastewater Discharge

Discharge of industrial wastewater to the land surface at INL is regulated by IDAPA 58.01.16 and IDAPA 58.01.17 and may require an industrial reuse permit (referred to in general terms as a wastewater reuse permit throughout the rest of this section). Wastewater reuse permits specify annual discharge volumes, application rates, and effluent primary and secondary constituent standards. Monitoring of non-radioactive parameters in the influent waste, effluent waste, and groundwater, as applicable, is required to demonstrate compliance with the permits. Annual reports are prepared and submitted to IDEQ, as required, and IDEQ inspects facilities for permit compliance on a regular basis. Some facilities also monitor specified radiological parameters for surveillance purposes, even though this may not be required by the different wastewater reuse permits. Compliance with Idaho groundwater quality primary constituent standards and secondary constituent standards in specified groundwater monitoring wells is generally required. Wastewater is discharged to the ground surface at the following areas on INL:

- INTEC New Percolation Ponds
- MFC Industrial Waste Pond, IWD, and sewage lagoons
- ATR Complex Cold Waste Pond
- NRF IWD
- CFA sprinkler irrigation system, used during summer months to apply industrial and treated sanitary wastewater

Per IDAPA 58.01.16 and 58.01.17, wastewater reuse permits are not usually required for INL sewage lagoons; however, lagoon effluent is generally monitored (frequency and methods are specific to the different facilities). Wastewater reuse permits have been obtained for the remaining ponds and ditches listed above, and for the CFA Sewage Treatment Facilities (ESER 2010). These facilities were sampled for parameters required by facility-specific permits, and no limits were exceeded in 2008 or 2009 (ESER 2009, ESER 2010).

NRF Wastewater Discharge

Industrial Waste Ditch

The IWD is an evaporative-percolation type wastewater disposal system where non-hazardous non-sewage wastewater, storm water, and snowmelt runoff are discharged from NRF. Much of the IWD is located outside the developed area of the facility and supports a variety of plant and animal life. The NRF IWD consists of two discrete drainage systems (BMPC 2009a). The interior IWD is comprised of a network of buried pipes, culverts, and open channels within the NRF security fence. This network empties into a covered exterior culvert, flows to an environmental monitoring station vault, and ultimately outfalls into two old stream beds that have been connected, straightened and deepened by dredging (e.g., removing sediment and plant material). The large uncovered portion of the IWD is 1 to 3 meters (3 to 10 feet) wide and progresses approximately 5.1 kilometers (3.2 miles) northeast from NRF into the desert where it is terminated by an earthen berm (the location and extent of the IWD is shown in several figures (e.g., Figures 3.4-6 and 3.4-7)). The berm prevents water from traveling further down this channel. Normally, no surface water is visible beyond 135 meters (450 feet) from the outfall.

In July 2007, IDEQ issued a wastewater reuse permit for maintaining and operating the NRF IWD. Inspections are performed bi-annually to determine if maintenance or repairs to the ditch or components are needed. Maintenance activities could include dredging (e.g., removing sediment and plant material from the interior of the ditch to improve infiltration), repairing areas of soil disturbance due to erosion or animal intrusion, or eradicating noxious weeds. The permit sets limits and conditions on the volume and type of effluent that is discharged to the IWD. The permit also requires certain non-radiological parameters to be monitored and stipulates the monitoring frequency. Even though there were no requirements prior to 2007, NRF has monitored the IWD as a best management practice for over 20 years.

The 5-year (2005-2009) minimum, maximum, and mean constituent data for the IWD are shown in Table 3.4-1. The wastewater reuse permit has primary constituent standards of 20 milligrams per liter and 100 milligrams per liter for 30-day average concentrations for total nitrogen and total suspended solids, respectively. Total nitrogen is calculated from the sum of total Kjeldahl nitrogen, nitrate, and nitrite. These limits were not exceeded in the IWD effluent based on the 5-year data (Table 3.4-1).

Table 3.4-1: Effluent Water Quality Analytical Results for the NRF IWD

Parameter[1]/ Units	Minimum[2]	Maximum[2]	Mean
	milligrams per liter (except as noted)		
Aluminum	<0.0104	<6.8	<<0.55
Antimony	<0.0005	0.5	<<0.02
Barium	0.0955	3.2	1.12
Chloride	57.2	32,500	7963
Iron	0.0181	4.92	<0.8
Manganese	0.00118	0.402	0.12
Nitrate as Nitrogen	<0.02	6.24	<1.2
Nitrite as Nitrogen	0.0183	16.4	<<4.6
Nitrogen (total Kjeldahl)	<0.01	3.08	<0.5
Oil and Grease	<1.09	28.4	<3.9
pH	7.22	9.19	8.2
Potassium	2.69	51.4	24.2
Sodium	36.4	13,500	4600
Specific Conductance (microsiemens per centimeter)	444	50,800	22,888
Sulfate	8.52	191	57.0
Thallium	0.000055	<0.5	<<0.03
Total Dissolved Solids	246	38,300	14,076
Total Suspended Solids	0.4	71.2	14.5

[1] Parameters that require monitoring per the NRF wastewater reuse permit. Monitoring requirements are permit-specific and differ among INL facilities.
[2]Actual minimums and maximums over the 5-year period (2005-2009) are reported.
< Value is less than the method detection limit (MDL). When applied to the mean, at least one "less than" value was used in the calculation. The MDL is dependent on the methods used in the analysis.
<< All values used in the mean calculation were less than the MDL.

The data for the IWD show no appreciable concentrations of heavy metals (aluminum, antimony, barium, iron, manganese, and thallium) and varying levels of non-hazardous salts containing ions of chloride, potassium, sodium, and sulfate. The three main sources of non-hazardous salts (e.g., sodium chloride and magnesium chloride) discharged to the IWD are: water softening solutions; salt used to de-ice NRF sidewalks and streets; and wastewater generated from the reverse osmosis process used to de-ionize water for use in the Expended Core Facility (ECF) water pools. Methods for reducing salt loading to the IWD from these sources are being considered by NRF. Based on past CERCLA evaluations (e.g., WEC 1997a and BMPC 2012) and Ecological Risk Assessments (WEC 1997b and DOE 2011d), the concentrations of constituents released from NRF to the IWD are not harmful to local wildlife (Section 3.5.6) or the environment. Additionally, downgradient groundwater wells show only small increases in some constituents compared to background concentrations (Section 3.4.2.2).

NRF operates a water reuse system (not to be confused with the wastewater reuse permit) in association with the operation of ECF whereby liquids containing radioactivity are collected, processed, and reused rather than discharged to the environment; however, NRF monitors liquid effluent into the IWD for radiological parameters on a weekly basis as a best management practice. Water samples collected from the IWD are analyzed for cobalt-60 (^{60}Co), cesium-137 (^{137}Cs), ^{3}H, and strontium-90 (^{90}Sr). Mean, minimum, and maximum analytical results for radiological parameters for the IWD are provided in Table 3.4-2.

Table 3.4-2: Radiological Liquid Effluent Parameters for the NRF IWD

	Mean[1]	**Minimum**[1]	**Maximum**[1]
Parameter	picocuries per liter		
^{60}Co	<<12.2	<5.0	<20.0
^{137}Cs	<<11.7	<5.0	<20.0
^{90}Sr	<<1.2	<0.6	<1.9
^{3}H	<<0.5	<0.1	<0.7

[1]Means, minimums, and maximums for ^{60}Co and ^{137}Cs are based on 5 years of data (2005-2009). Means, minimums, and maximums for ^{90}Sr and ^{3}H are based on 2 years of data (2008-2009). Actual minimums and maximums over the 5-year or 2-year period are reported.
< Value is less than the MDL. The MDL is dependent on the methods used in the analysis.
<< All values used in the mean calculation were less than the MDL.

All IWD ^{60}Co and ^{137}Cs radiological effluent sample results for 2005-2009 were less than (<) their method detection limits (MDLs). MDLs are constituent specific and depend on the methods used in the analysis. All ^{90}Sr and ^{3}H results were less than their MDL levels for 2008-2009. The derived EPA MCLs for drinking water are:

- ^{60}Co = 100 picocuries per liter
- ^{137}Cs = 200 picocuries per liter
- ^{90}Sr = 8 picocuries per liter
- ^{3}H = 20,000 picocuries per liter

While these MCLs are for drinking water, they provide a comparison to show that radioactivity in the IWD effluent samples is low compared to drinking water standards.

Sewage Lagoons

In 2012, NRF put two new high-density polyethylene (HDPE) lined evaporative sewage lagoons into operation (i.e., the active sewage lagoons). Each active sewage lagoon has an area of approximately 4.3 hectares (10.5 acres) and is located directly northeast of the two retired sewage lagoons (Figure 3.4-3). The active sewage lagoons are large basins constructed of earthen dikes to retain sanitary wastewater. Treatment of sewage occurs through natural aerobic processes. Liquid is evaporated from the active sewage lagoons, thus producing no effluent discharge. The active sewage lagoons are limited to treating municipal wastewater and are not designed for industrial or radiological wastewater.

The design, operation, and maintenance of the active sewage lagoons are in compliance with regulations and recommendations of the State of Idaho Wastewater Rules under IDAPA 58.01.16. The required Preliminary Engineering Report (Baker 2010) and Operations and Maintenance Manual (Baker 2012) were approved by IDEQ pursuant to IDAPA 58.01.16. Leak testing was performed, and all state requirements were met in 2012 prior to putting the lagoons into service.

The two active sewage lagoons (of equal size) can operate in parallel, in series, or isolated (i.e., one sewage lagoon at a time). The active sewage lagoons were designed for a nominal discharge of approximately 182,000 liters (48,000 gallons) per day. This was based on a population of 1600 people with discharge of approximately 114 liters (30 gallons) per day per person. Annual discharge, based on the daily discharge and assumption that there are 250 working days per year, is estimated at 45,420,000 liters (12,000,000 gallons) per year. Design conservatisms in operating depth and availability of the second active sewage lagoon allow for variation in operating conditions that include wetter than average years and periods when there are more people on-site (up to 1800).

Thus, the nominal operating parameters provided do not represent operational limits for the active sewage lagoons.

The baseline flow to the active sewage lagoons is estimated to be 39,000,000 liters (10,300,000 gallons) per year and 155,000 liters (41,000 gallons) per day based on an estimated population of 1370 workers for Fiscal Year (FY) 2012.

Prior to use of the active sewage lagoons, sanitary wastewater at NRF was conveyed to the northeast cell of two retired sewage lagoons (Figure 3.4-3). The southwest cell has been dry for several years. These were facultative lagoons, which combined aerobic and anaerobic digestion to break down solids. Most of the remaining liquid was dissipated by evaporation; however, subsurface seepage of liquid effluent from the northeast cell when it was active created a shallow perched water zone beneath the retired sewage lagoons. Average sanitary wastewater discharged to the retired sewage lagoons based on data from 2005-2009 was approximately 39,000,000 liters (10,300,000 gallons) per year, with 13,200,000 liters (3,500,000 gallons) per year generated from ECF. The retired sewage lagoons are listed as CERCLA sites.

There are no non-radiological effluent monitoring requirements for the active sewage lagoons; however, the retired sewage lagoons were monitored for similar parameters and on the same frequency as the IWD. The 5-year (2005-2009) minimum, maximum, and mean non-radiological constituent data for the retired sewage lagoons are shown in Table 3.4-3. The constituent concentrations of sewage effluent are typical of ranges expected in a non-aerated evaporative sewage treatment lagoon, and downgradient groundwater wells show negligible impact. Monitoring for non-radiological parameters is not necessary for the active sewage lagoons because this information is not required for day-to-day operation, the likelihood of inadvertent releases to these active sewage lagoons is considered to be very low, and the HDPE liners prevent releases to the environment. It is expected that constituent concentrations in the active sewage lagoons will be within the range reported for the retired sewage lagoons.

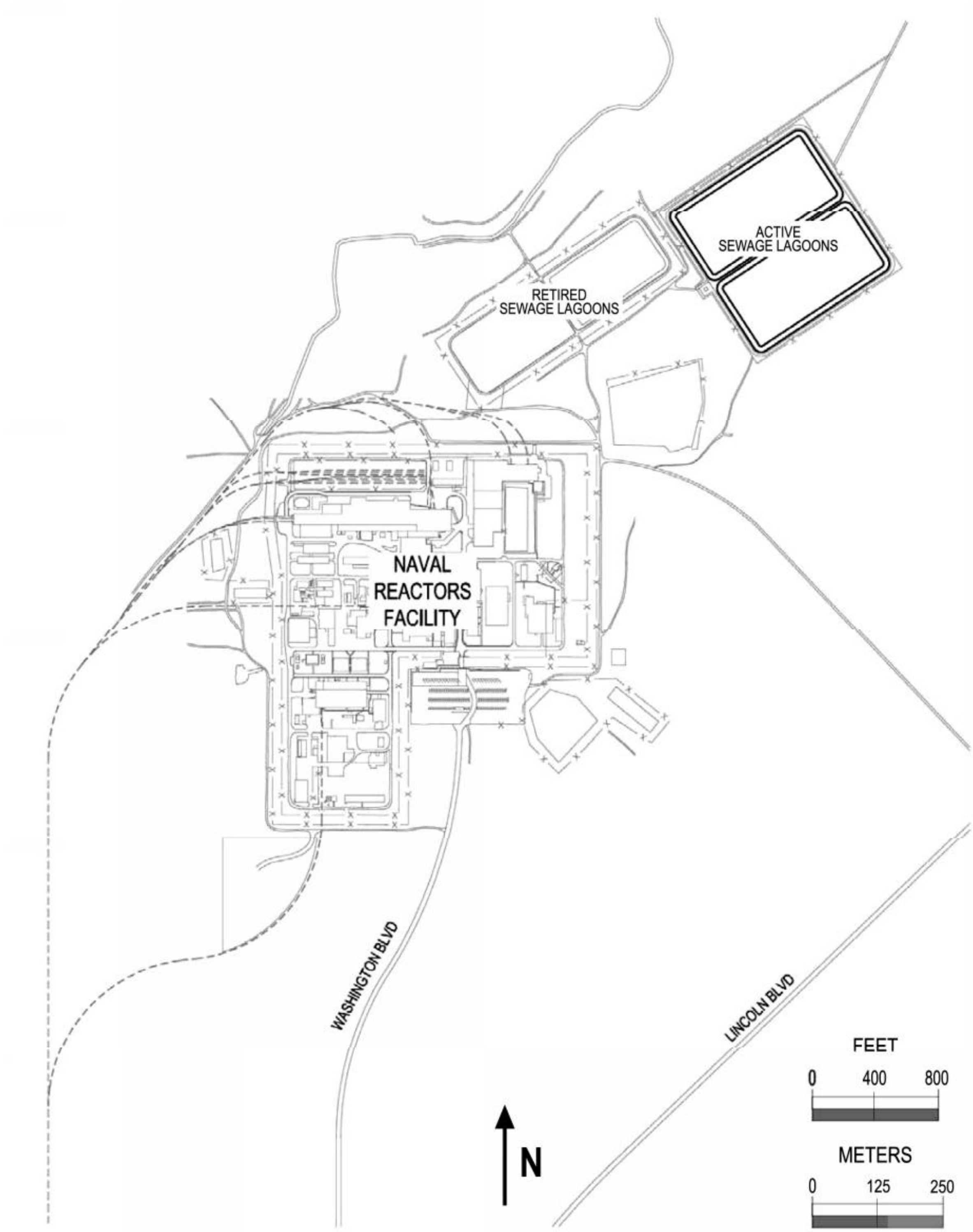


Figure 3.4-3: Location of Active and Retired Sewage Lagoons at NRF

Table 3.4-3: Effluent Water Quality Analytical Results for NRF Retired Sewage Lagoons

Parameter / Units	Minimum[1]	Maximum[1]	Mean
	milligrams per liter (except as noted)		
Aluminum	0.027	19.3	<0.9
Antimony	0.000583	0.0148	<<0.005
Barium	0.0126	0.591	0.082
Chloride	8.78	260	130
Iron	0.162	28.1	1.8
Manganese	0.0095	0.656	0.06
Nitrate as Nitrogen	< 0.02	4.96	<< 0.23
Nitrite as Nitrogen	<0.03	0.695	<0.14
Nitrogen (total Kjeldahl)	<0.033	173	<29.9
Oil and Grease	<0.722	32.2	<6.6
pH	7.39	11.2	9.0
Potassium	16.9	36.2	27.8
Sodium	17.1	518	212
Specific Conductance (microsiemens per centimeter)	157	2740	1255
Sulfate	4.46	103	63
Thallium	0.00025	0.0235	<<0.005
Total Dissolved Solids	18.8	1520	647
Total Suspended Solids	4.88	5640	284

[1]Actual minimums and maximums over the 5-year period (2005-2009) are reported.
< Value is less than the method detection limit (MDL). When applied to the mean, at least one “less than” value was used in the calculation. The MDL is dependent on the methods used in the analysis.
<< All values used in the mean calculation were less than the MDL.

NRF monitors liquid effluent into the active sewage lagoons for radiological parameters (^{60}Co, ^{137}Cs, ^{3}H, and ^{90}Sr) on a quarterly basis as a best management practice. All retired sewage lagoon radiological effluent samples were below their MDLs over the same periods shown in Table 3.4-2 for the IWD (BBI 2005, BBI 2006b, BBI 2007, BMPC 2008, BMPC 2009a).

3.4.1.4 Storm Water

INL Storm Water Discharges

Storm water from INL facilities is generally discharged to industrial waste ditches or infiltration ponds. Because storm water from INL facilities is not discharged to the Big Lost River, the National Pollutant Discharge Elimination System (NPDES) permit provisions for discharges into regulated surface waters do not apply to INL operations.

For construction storm water discharges, INL facilities maintain compliance with *INL’s NPDES General Permit for Storm Water Discharges from Construction Sites*, issued by the EPA in June 1993. Coverage under the general permit has been renewed twice (ESER 2011). INL contractors obtain coverage under the general permit and develop storm water pollution prevention plans for individual construction projects if it is determined there is reasonable potential to discharge pollutants to regulated surface waters. The general permit and plan provide best management practices to prevent pollution of storm water from construction activities at INL.

NRF Storm Water Discharges

At NRF, storm water (including construction storm water) is discharged to the IWD, to the active sewage lagoons, or directly to infiltration ponds and trenches. Storm water may result in minor overland flow (usually limited to flow of only a few meters in length) that infiltrates into the ground. Storm water that is discharged to the active sewage lagoons is contained, and storm water discharged to infiltration ponds or trenches evaporates or infiltrates the ground surface. Thus, there is no potential for storm water discharged to the active sewage lagoons, infiltration ponds, trenches, or to the ground to reach regulated waters (i.e., the Big Lost River).

The maximum annual discharge (storm water and non-radiological process wastewater) to the IWD occurred in 1992 with a volume of approximately 650,000,000 liters (172,000,000 gallons) (BMPC 2012). At this maximum discharge volume, water flow in the IWD was observed to a distance of approximately 2.9 kilometers (1.8 miles) and did not reach the berm that blocks flow from traveling further down the channel. In 1993, infiltration was studied along the length of the IWD as part of the CERCLA Remedial Investigation/Feasibility Study (WEC 1994). It was determined that operational discharge of 270,000,000 liters (71,000,000 gallons) over 3 months terminated at approximately 1.8 kilometers (1.1 miles). Since 2000, annual discharge from NRF has averaged about 30,300,000 liters (8,000,000 gallons), with a discharge of approximately 43,200,000 liters (11,400,000 gallons) in 2009. Thus, under past and current conditions, storm water discharges from NRF do not reach the Big Lost River and the NPDES permit provisions for discharges into regulated waters do not apply.

Based on IWD infiltration studies (e.g., WEC 1994), climate, distance to the Big Lost River, and local topography, it was determined that there is no reasonable potential for construction storm water to be discharged to regulated surface waters. A technical paper to support this position is provided in Response to Comment Document #31 in Appendix G. Therefore, NRF does not operate under *INL's General Permit for Storm Water Discharges from Construction Sites* or need its own NPDES construction general permit (see Appendix B.4). As a best management practice, NRF maintains a Wastewater Management Plan which includes sediment and erosion controls for storm water runoff. Additionally, requirements for managing storm water are included in contract specifications for subcontractors responsible for construction projects.

3.4.1.5 Floodplains

Flood frequency is typically characterized by the recurrence interval of a flood (or flow). The recurrence interval is the average period of time that elapses between floods of a given size. Larger floods are more infrequent, and therefore, have a larger recurrence interval. Recurrence intervals are calculated based on historical measurements of flow and on geologic evidence of flooding. The 100-year flood does not necessarily occur once every 100 years, but rather has a 1 in 100 (1 percent) probability of occurring in any given year. The 500-year flood may occur more or less than once in a 500-year period, but has only a 1 in 500 (0.2 percent) probability in any given year. A probable maximum flood is a hypothetical flow scenario that is used to place an upper bound on the impacts of flooding and is usually several times larger than the maximum recorded flood. It is not assigned a probability, but is intended to represent the combination of events (snowmelt, precipitation, and dam failure) that could lead to maximum streamflow.

In DOE 2005b, Appendix F, a preliminary floodplain/wetland assessment was prepared to evaluate potential effects of proposed haul roads on the Big Lost River floodplain and the wetlands in the Big Lost River sinks. The assessment primarily discussed INTEC and the ATR Complex, but included locations of other INL facilities (e.g., NRF) in the mapping analysis. Executive Order (EO) 11988

(Floodplain Management) requires that potential effects of actions must be evaluated, if those actions will be conducted within a floodplain. The EO defines “floodplain” as follows:

> The term “floodplain” shall mean the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to one percent or greater chance of flooding in any given year (i.e., a 100-year floodplain).

NRF does not reside in the 100-year or 500-year floodplains of the Big Lost River (BMPC 2012); therefore, the requirements for a floodplain assessment in EO 11988 do not apply to the proposed action.

The INL diversion dam, constructed in 1958 and enlarged in 1984, was designed to secure that portion of INL located on the Big Lost River flood plain from the 300-year flood of the Big Lost River, by directing flow through a diversion channel into four spreading areas (Figure 3.4-4).

The estimated flood hazard area for a probable maximum flood due to failure of the Mackay Dam is provided in Figure 3.4-4. The flood inundation area includes the west-central portion of INL along the Big Lost River drainage. Because the ground surface at INL is relatively flat, floodwaters outside the banks of the Big Lost River would spread over a large area and pond in the lower lying areas. Although predicted flood velocities would be relatively slow with shallow water depths, some facilities could be impacted.

NRF land area is within this probable maximum flood hazard area (Figure 3.4-4). The land surface at NRF is relatively flat, with elevations ranging from 1475 meters (4840 feet) above sea level near the wetted end of the NRF IWD, which is located approximately 370 meters (1200 feet) north of NRF, to 1484 meters (4870 feet) above sea level along the south side of NRF (BMPC 2012). Flooding at NRF is not likely, since the facility is not located within the current 100-year flood plain. A flood of the Big Lost River with a recurrence interval in excess of 10,000 years is capable of inundating NRF (Ostenaa 1999).

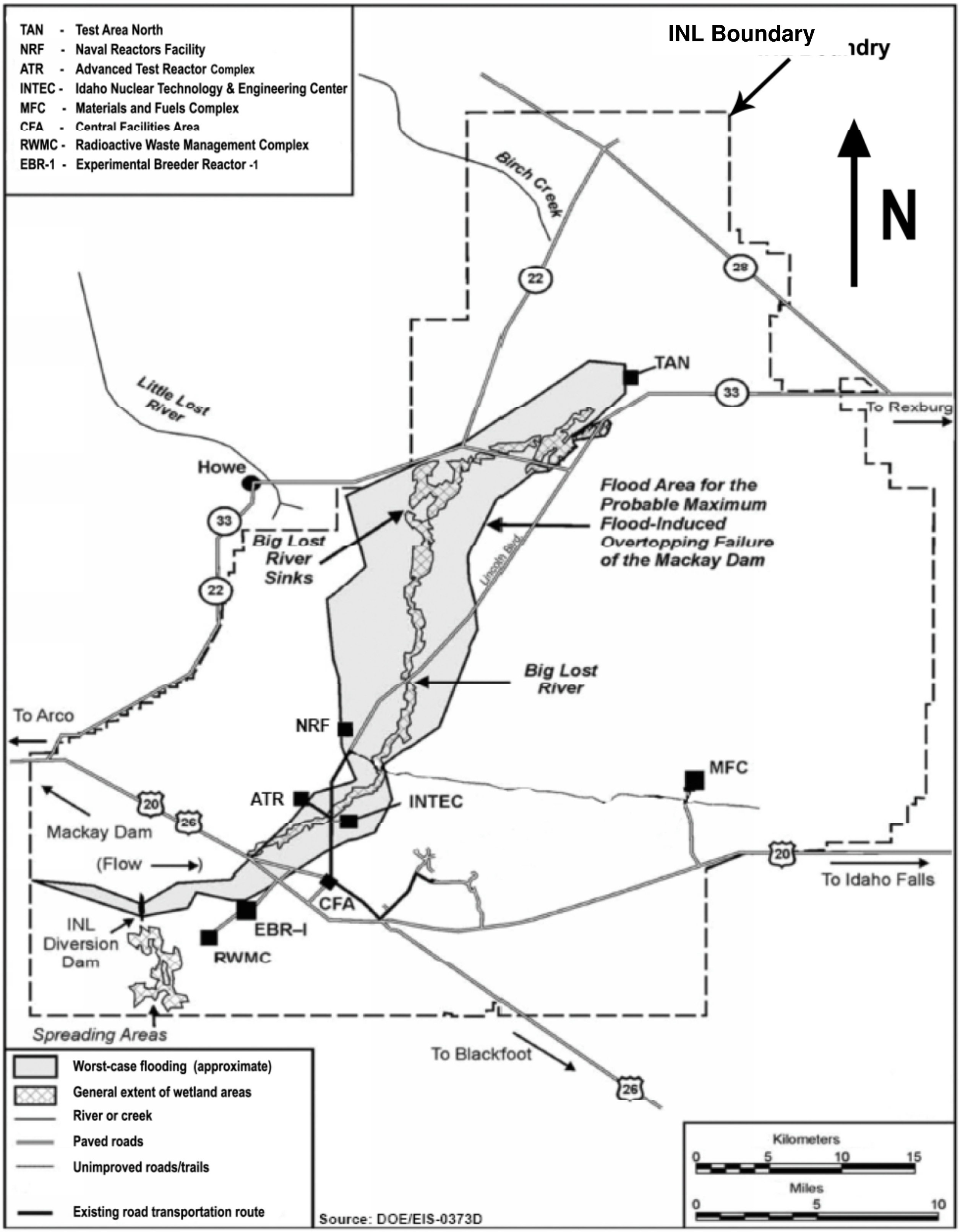


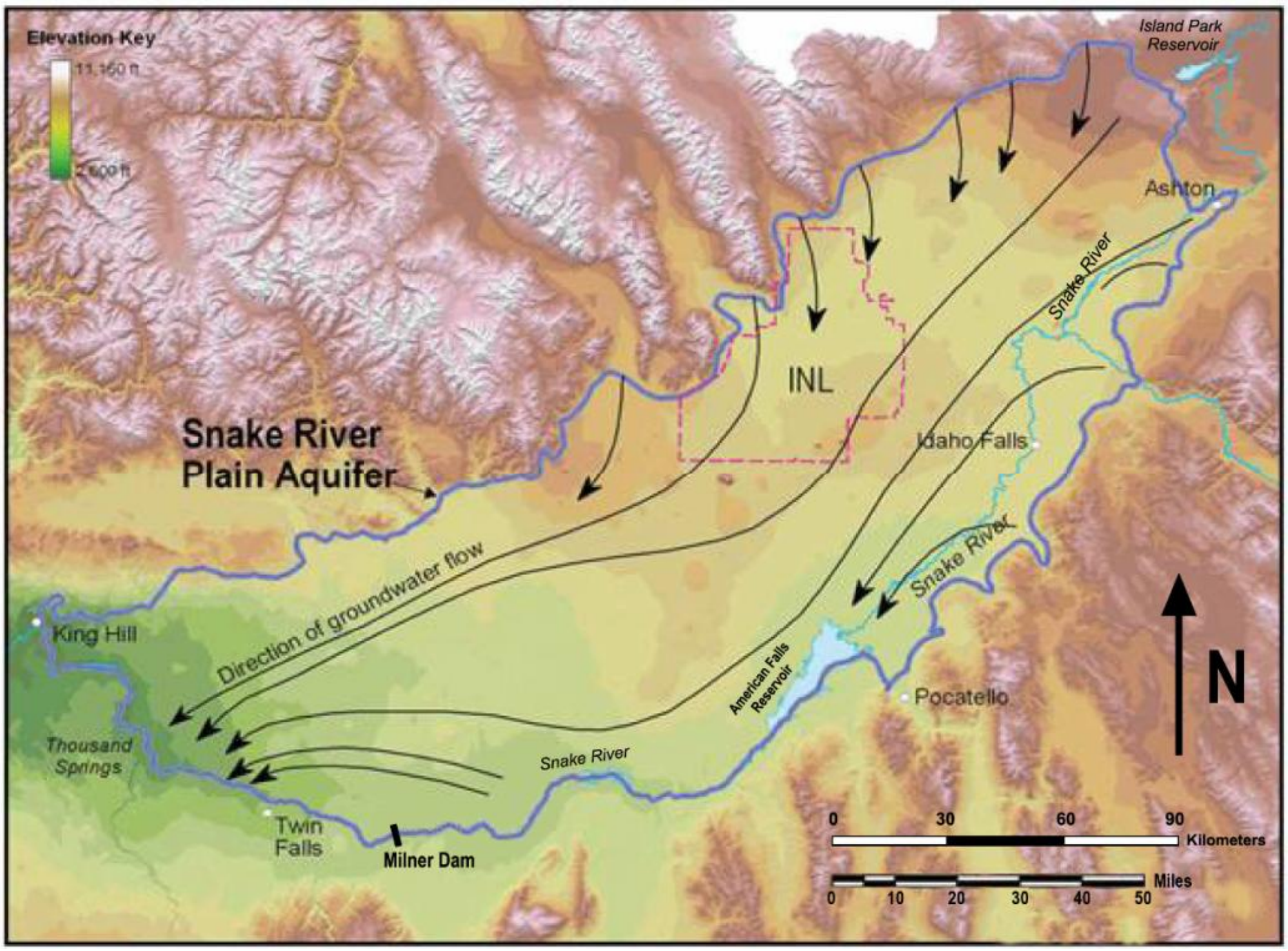
Figure 3.4-4: Surface Water Features, Wetlands, and Flood Hazard Areas at INL

3.4.2 Groundwater

3.4.2.1 Local Hydrology

Snake River Plain Aquifer

Groundwater in the ESRP is contained primarily in one major unit known as the SRPA. The SRPA lies beneath INL. It covers approximately 25,000 square kilometers (9600 square miles) in southeastern Idaho (Figure 3.4-5). Aquifer boundaries are formed by contact of the aquifer with less permeable rocks at the margins of the ESRP. These boundaries correspond to the mountains on the west and north and the Snake River on the east.



Source: ESER 2009

Figure 3.4-5: SRPA Boundaries, Direction of Groundwater Flow, and Surrounding Communities

The SRPA is the major source of drinking water and crop irrigation for southeastern Idaho and has been designated a Sole Source Aquifer by EPA (ESER 2011). Water storage in the aquifer is estimated at approximately 1.2 quadrillion to 2.5 quadrillion liters (317 trillion to 660 trillion gallons). The aquifer is composed of numerous relatively thin basalt flows with interbedded sediments extending to depths ranging from 610 to 3048 meters (2000 to 10,000 feet). The interbeds accumulated over time, as some basalt flows were exposed at the surface long enough to collect sediment. These sedimentary interbeds lie at various depths, with their distribution and continuity controlled by basalt flow topography, sediment input, and subsidence rate. In some instances, the process of sediment accumulation resulted in discontinuous distributions of relatively impermeable sedimentary interbeds, which facilitate the formation of localized perched groundwater (subsurface water bodies above the regional groundwater table).

Transmissivity is a measure of the rate at which water is transmitted through a unit width of aquifer to hydraulically downgradient areas and to pumping wells. Transmissivity in the SRPA ranges from approximately 0.1 to 71,000 square meters (1.1 to 760,000 square feet) per day and averages approximately 8600 square meters (93,000 square feet) per day. Groundwater flow rates in the aquifer have been reported to range from about 0.5 to 6.1 meters (2 to 20 feet) per day (ESER 2011). Regionally, water in the aquifer moves horizontally, mainly through fractures in the basalts and basalt interflow zones. Interflow zones are comprised of highly permeable rubble zones between basalt flows. Groundwater flow in the SRPA is primarily toward the southwest (Figure 3.4-5).

The Big Lost River, Little Lost River, and Birch Creek terminate at sinks on or near INL (Figure 3.4-2) and recharge the aquifer (when flow is present). Recharge occurs when water infiltrates through the surface of the ESRP from flow in the channel of the Big Lost River, the sinks, Little Lost River, Birch Creek, and Mud Lake. Additionally, recharge may occur from melting of local snowpacks, during years in which snowfall accumulates on the ESRP, and from local agricultural-irrigation activities. Valley underflow from the mountains to the north and northeast of the ESRP has been cited as a source of recharge. Water is discharged from the SRPA through large springs, which flow into the Snake River, and from water pumped for irrigation. The aquifer discharges approximately 8.8 billion cubic meters (311 billion cubic feet) of water annually to springs and rivers. Major areas of springs and seepages from the aquifer occur in the vicinity of the American Falls Reservoir (southwest of Pocatello) and the Thousand Springs area (near Twin Falls, Figure 3.4-5), between Milner Dam and King Hill.

<u>INL</u>

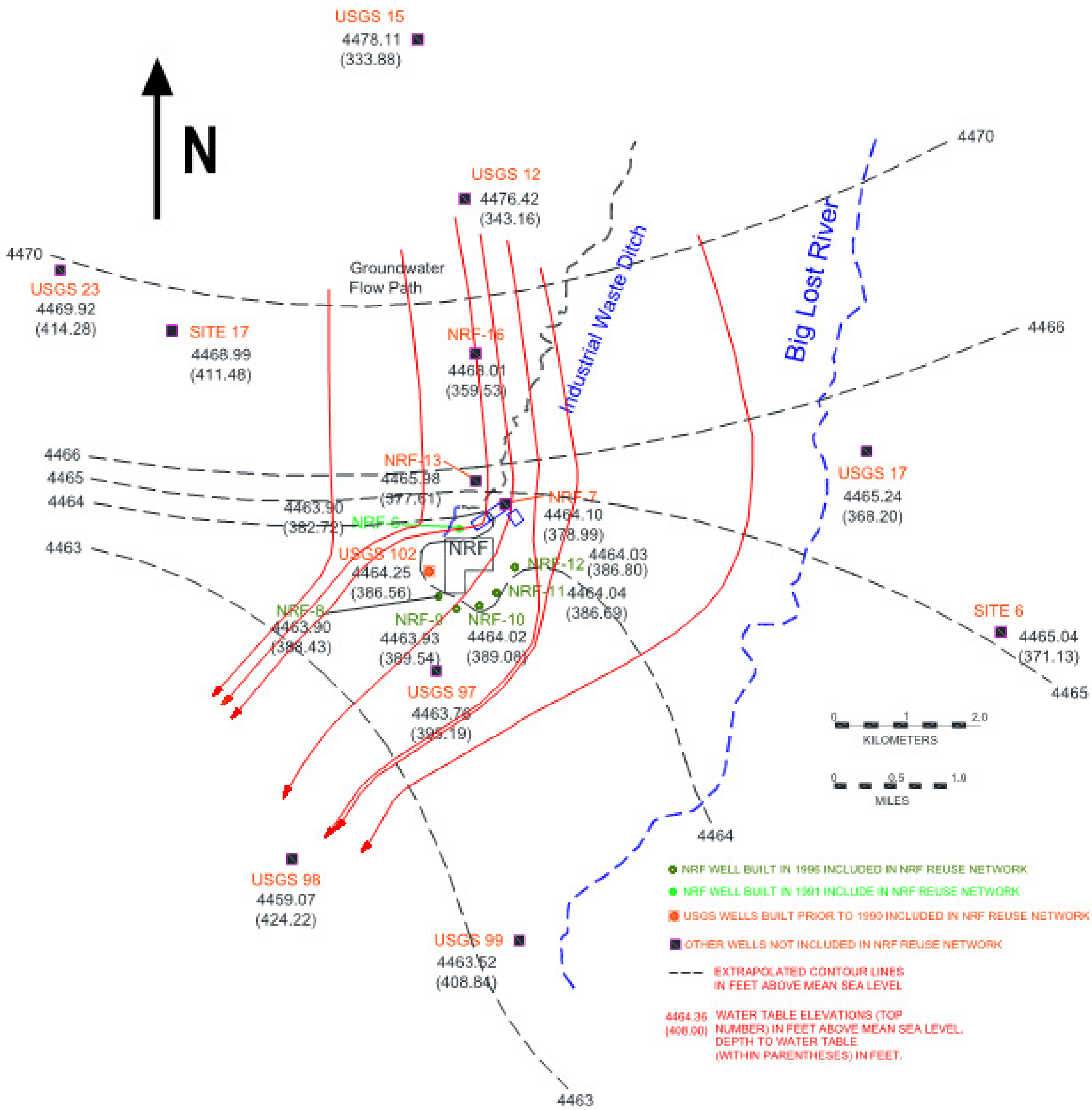
The U.S. Geological Survey (USGS) estimates that the thickness of the active portion of the SRPA at INL ranges between 75 and 250 meters (250 to 820 feet). Depth to the water table ranges from about 60 meters (200 feet) below land surface in the northern part of INL to about 300 meters (1000 feet) in the southern part. Numerous USGS publications further describe the hydrogeologic conditions of the SRPA. Some of these publications can be accessed from the USGS INL Project Office web site (USGS 2011).

<u>NRF</u>

Water table elevations and depth to the SRPA based on data collected from NRF wells in November 2011 are provided in Figure 3.4-6. Depth to the aquifer ranges from 102 meters (334 feet) at USGS Well 15 located approximately 5 kilometers (3 miles) north of NRF to 129 meters (424 feet) in USGS Well 98 located approximately 5 kilometers (3 miles) south of NRF.

At NRF, calculated transmissivity in the aquifer ranges from approximately 0.3 to 53,500 square meters (3 to 576,000 square feet) per day, and varies with well location (BMPC 2012). The minimum transmissivity value of 0.3 square meters (3 square feet) per day is associated with a well that was completed in an aquifer area that may lack rubble zones and fractures; therefore, it exhibits abnormally low hydraulic conductivity values. A well with a transmissivity of 0.3 square meters (3 square feet) per day can produce approximately 11,400 liters (3000 gallons) of water per day, while a well with a transmissivity of 53,500 square meters (576,000 square feet) per day can produce in excess of 11,400,000 liters (3,000,000 gallons) per day (BMPC 2012). Hydraulic conductivity (rate at which water can move through a permeable medium) in the aquifer at NRF ranges from approximately 1.3 to 256,400 meters (4.4 to 841,200 feet) per year (WEC 1997a). It should be noted that groundwater flow rates within the aquifer, which are related to hydraulic conductivity values, range between 1.5 meters (5 feet) and 4.6 meters (15 feet) per day, or between 560 meters (1820 feet) and 1670 meters (5480 feet) per year. On a local basis, the flow direction can be affected by recharge from rivers, surface water spreading areas, and heterogeneities in the aquifer. At NRF, groundwater flow is generally from north to south (Figure 3.4-6).

With greater distances to the aquifer, more soil, sedimentary interbeds, and rock materials are present to inhibit the downward migration of potential contaminants through various absorption mechanisms, and thereby reduce the risk that contaminants will reach the aquifer. Based on analysis of a contaminant (sulfate ion) that moves at approximately the rate of water, it takes 22 to 33 months to migrate from the IWD to the aquifer at well NRF-6. The travel time for this contaminant is facilitated by a continuous discharge of wastewater from the surface to the aquifer and is significantly shorter than the time it would take potential contaminants located at the ground surface to reach the aquifer if carried by precipitation only. Because of the limited amount and periodic nature of precipitation at the INL, which accounts for the low aquifer recharge rate from precipitation (2.5 to 8 centimeters per year (1-3 inches per year)) (USGS 1992), and the distance to the aquifer (approximately 115 meters (380 feet) at NRF), it would take contaminants approximately 1,500 to 1,600 years to percolate through the soil and rocks to the aquifer below when assuming a percolation rate of 8 centimeters (3 inches) per year. Travel times could be much greater if the effects due to soil adsorption mechanisms and the presence of perched water zones are included. Constituent travel times gradually increase south of NRF due to an increase in the distance to the aquifer (e.g. about 300 meters (1000 feet) at the southern INL boundary).



Source: BMPC 2012

Figure 3.4-6: Water Table Contour Map With Direction of Groundwater Flow for NRF

Perched Water

INL

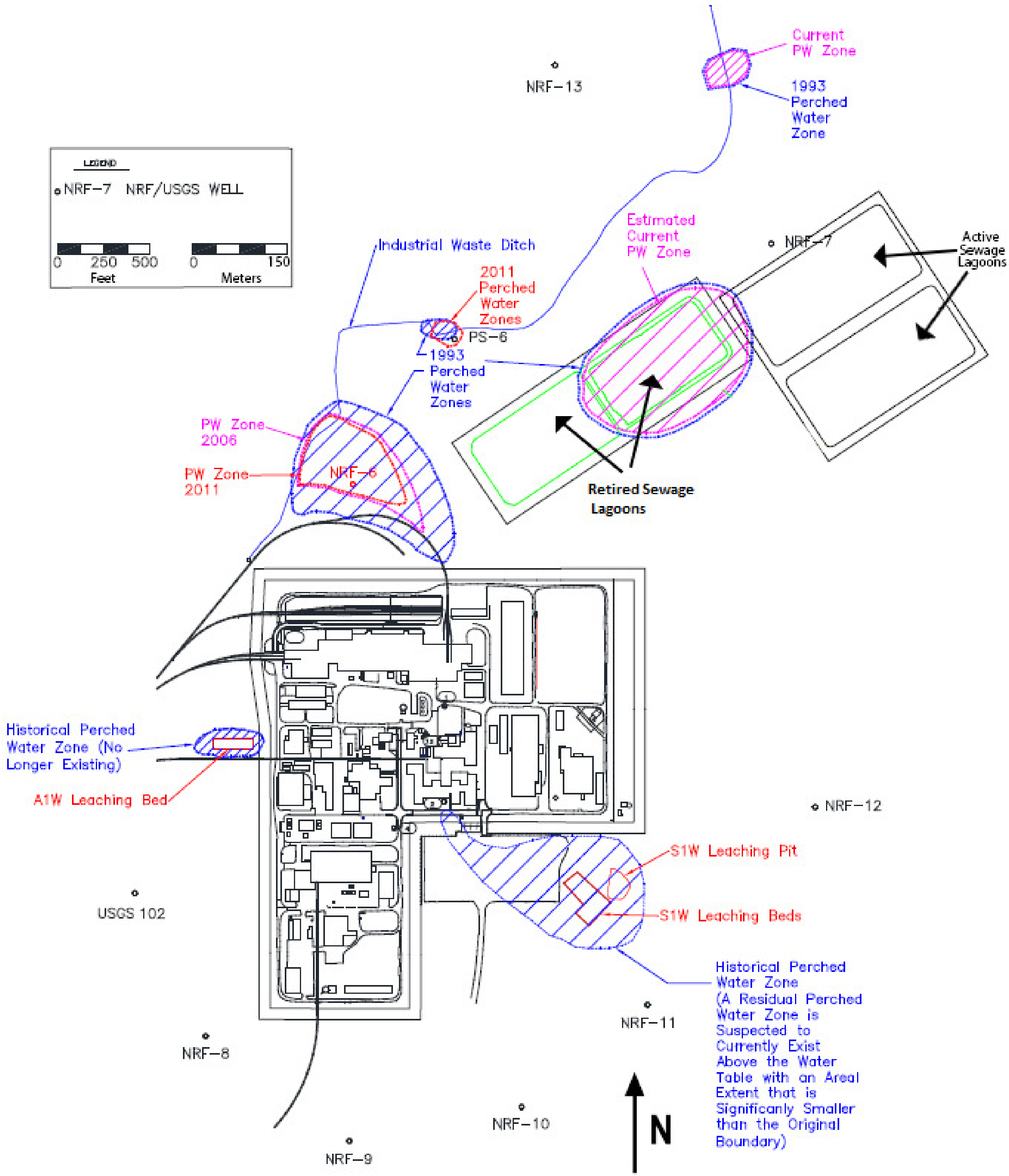
Perched water commonly occurs in the vadose zone (unsaturated zone between the ground surface and the aquifer) below the INL, in areas where a substantial surface recharge source is present. Deeper perched water zones are also known to exist. Perched water occurs when sediments or dense basalt with low permeability impede the downward flow of water to the aquifer. These perched water tables tend to slow the migration of pollutants that might otherwise quickly reach the SRPA. If the basalt surface that causes the perched water to form is sloped, then perched water will flow down slope along that surface. Any contaminants that may be present in the water will be carried along with the water to locations that may be some distance from their origin. This phenomenon has the potential of creating phantom contamination, which is the occurrence of contamination for which no apparent source exists. Perched water tables have been detected beneath INL and are mainly attributed to the volume of water discharged to disposal ponds, sewage lagoons, or industrial waste ditches (ESER 2006).

NRF

At NRF, perched water is known to occur beneath the IWD, the retired sewage lagoons, and historically beneath leaching beds/pits associated with prototype reactors (Figure 3.4-7). Figure 3.4-7 provides a historical perspective of perched water at NRF. The figure shows the estimated extent of perched water (from water level measurements in 2011) along the IWD and at the retired sewage lagoons, compared to the extent in 1993 and 2006. The locations and extent of historical perched water zones at the Large Ship Reactor Prototype (A1W) and Submarine Thermal Reactor Prototype (S1W) leaching beds and an area located approximately 300 meters (1000 feet) north of the retired sewage lagoons are also shown.

The most significant perched water zone is beneath and east of the outfall of the IWD (Figure 3.4-7). The areal extent of this zone is directly related to water discharge volumes to the IWD. Discharge volume to the IWD was reduced between 1993 and 2000 (Figure 3.4-8), due to changes in operations that included shutting down the S1W prototype, the A1W prototype, and the Submarine Reactor Plant Prototype (S5G). Discharge volume varied through 2010, but remained relatively low compared to past years. Reduction in discharge volume resulted in a 20 percent reduction in the areal extent of the perched water located at the outfall of the IWD, and the disappearance of the perched water zone, located approximately 300 meters (1000 feet) northeast of well NRF-6 (Figure 3.4-7). Perched water located below the IWD contains residual constituents that are either no longer discharged to the IWD, or are discharged at lower concentrations than are found in groundwater monitoring wells. This is evidenced by concentrations of constituents (e.g., sulfate ions and ^{3}H) in groundwater monitoring wells that are higher than concentrations in IWD effluent. It is believed that these constituents are slowly being released as perched water drains to the aquifer below. By the time water from perched water zones reaches the aquifer, most constituent concentrations are at or near background levels as evidenced by the Effluent System Well (NRF-6) and downgradient well groups (Table 3.4-6). (BMPC 2012)

The retired sewage lagoons were designed to be evaporative ponds; however, subsurface seepage of liquid effluent from the northeast cell has created a shallow perched water zone beneath the retired sewage lagoons (Figure 3.4-7). This water contains non-hazardous chemicals (salts). The perched water zone was estimated to be approximately the same size in 2010 as it was in 1993 (Figure 3.4-7). The retired sewage lagoons were placed out of service in 2012. The size of this perched water zone is expected to decrease substantially once the retired sewage lagoons are dry.



Source: BMPC 2012

Figure 3.4-7: Perched Water Zones at NRF

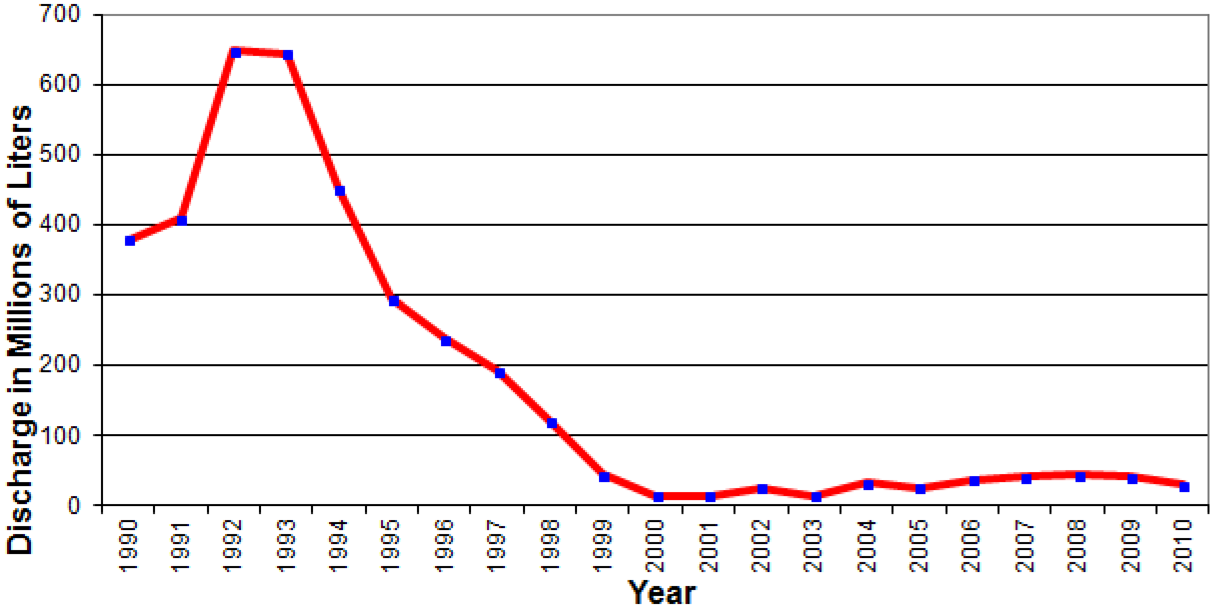


Figure 3.4-8: Discharge Volumes to the NRF IWD Through 2010

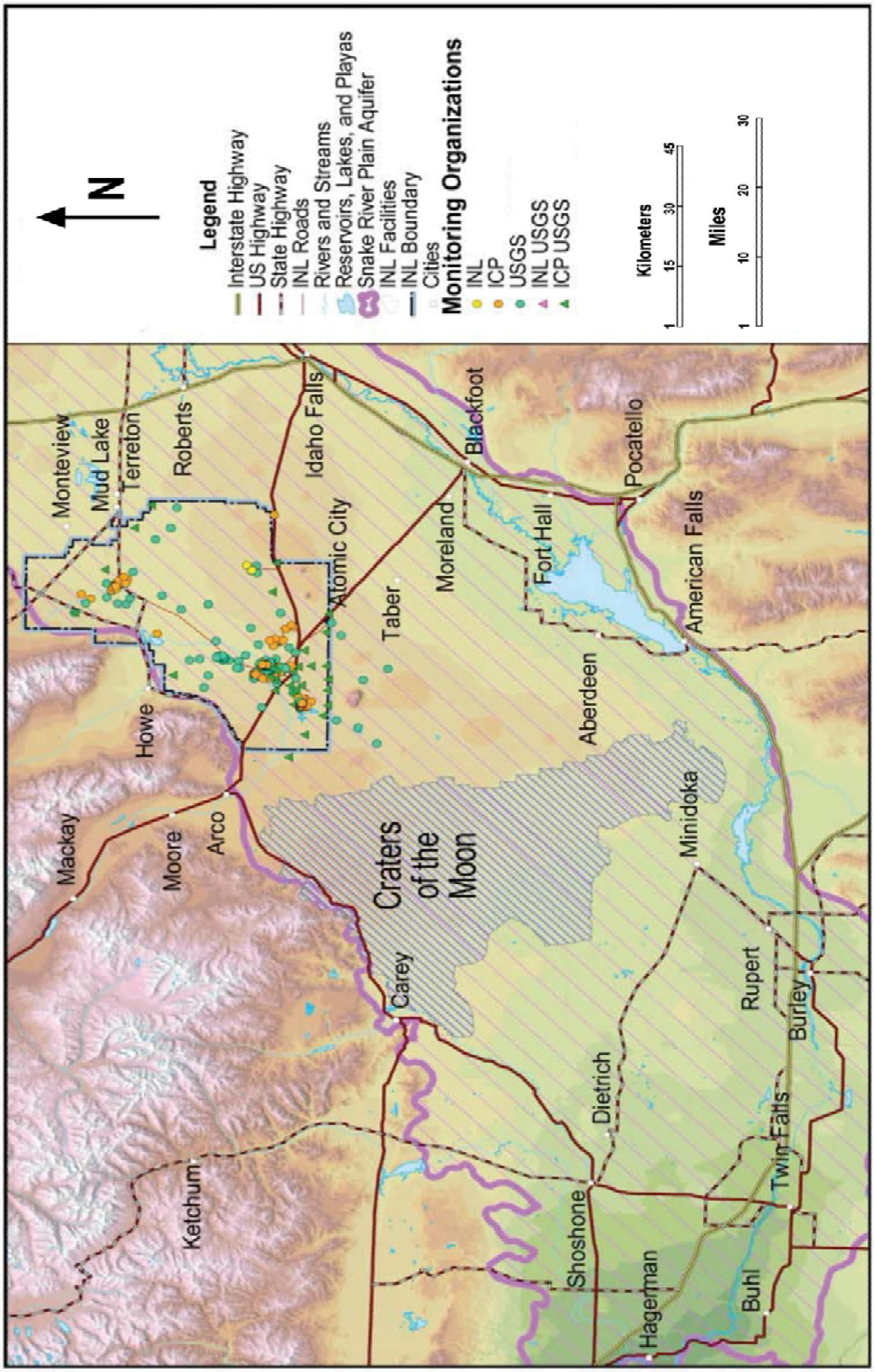
3.4.2.2 Subsurface Water Quality

INL Groundwater Monitoring Network

The USGS INL Project Office and INL contractors perform groundwater monitoring, analyses, and studies of the SRPA under and adjacent to INL. Groundwater monitoring is required by a variety of permits and by CERCLA RODs related to remedial action requirements for WAGs established on INL (see below for WAG description). In addition, the USGS has conducted numerous studies of the SRPA. The Environmental Surveillance, Education and Research (ESER) contractor, Gonzales Stoller Surveillance (formerly S.M. Stoller Corporation), performs groundwater monitoring at off-site wells.

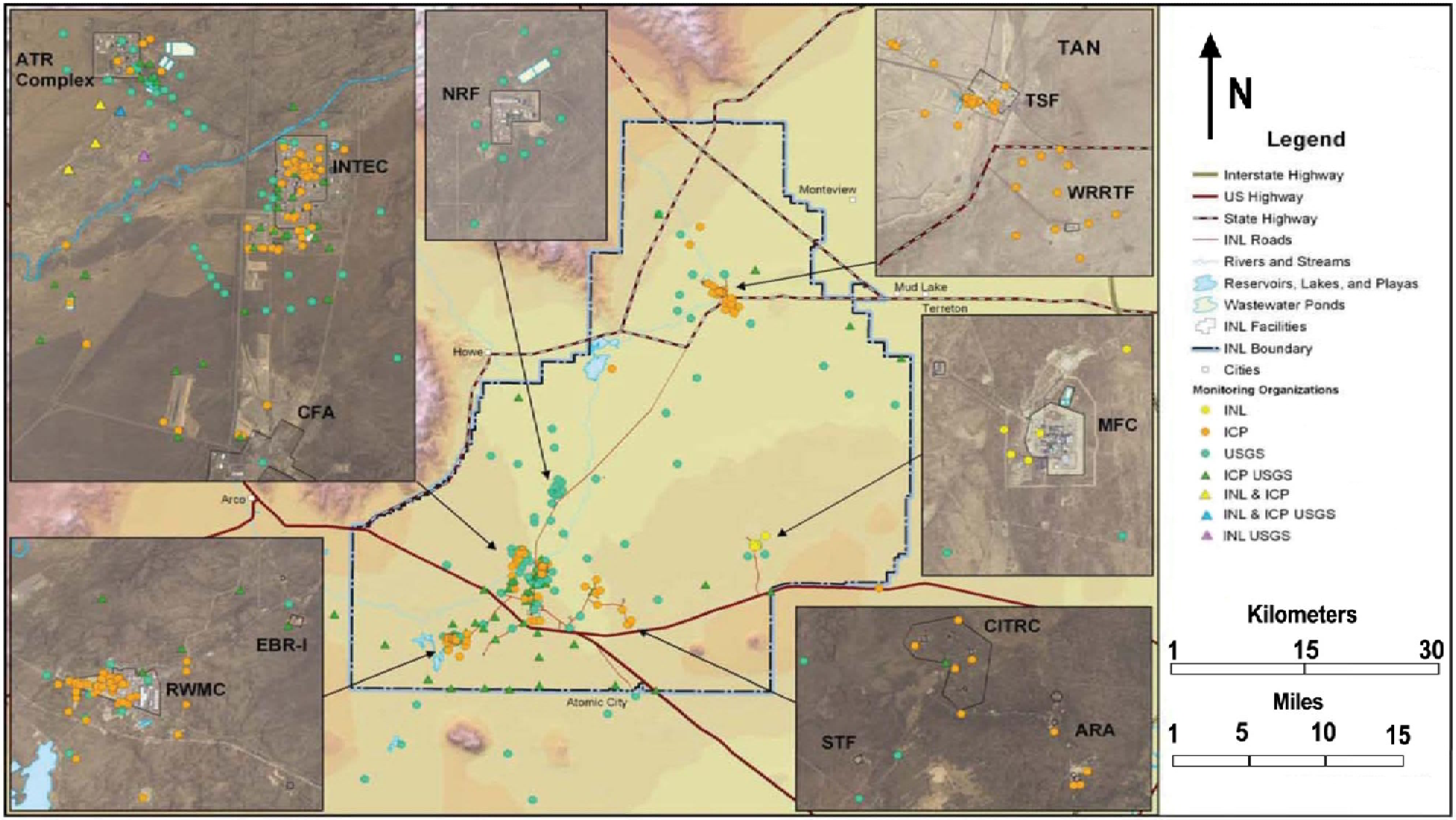
INL has an extensive groundwater quality monitoring network maintained by the USGS and INL contractors. Figures 3.4-9 and 3.4-10 show this monitoring network from regional and INL facility perspectives, respectively. This network includes 178 monitoring or production wells in the SRPA, from which samples are collected and analyzed for selected organic, inorganic, and radioactive constituents. NRF maintains its own groundwater monitoring program (discussed below).

CERCLA activities at INL are divided into 10 WAGs (Figure 3.4-11). Each WAG monitors specific groundwater contaminants associated with remedial actions implemented according to the requirements of the associated RODs (ESER 2011). WAG 10 has been designated as INL-wide and addresses the combined impact of the individual contaminant plumes. NRF is covered by WAG 8.



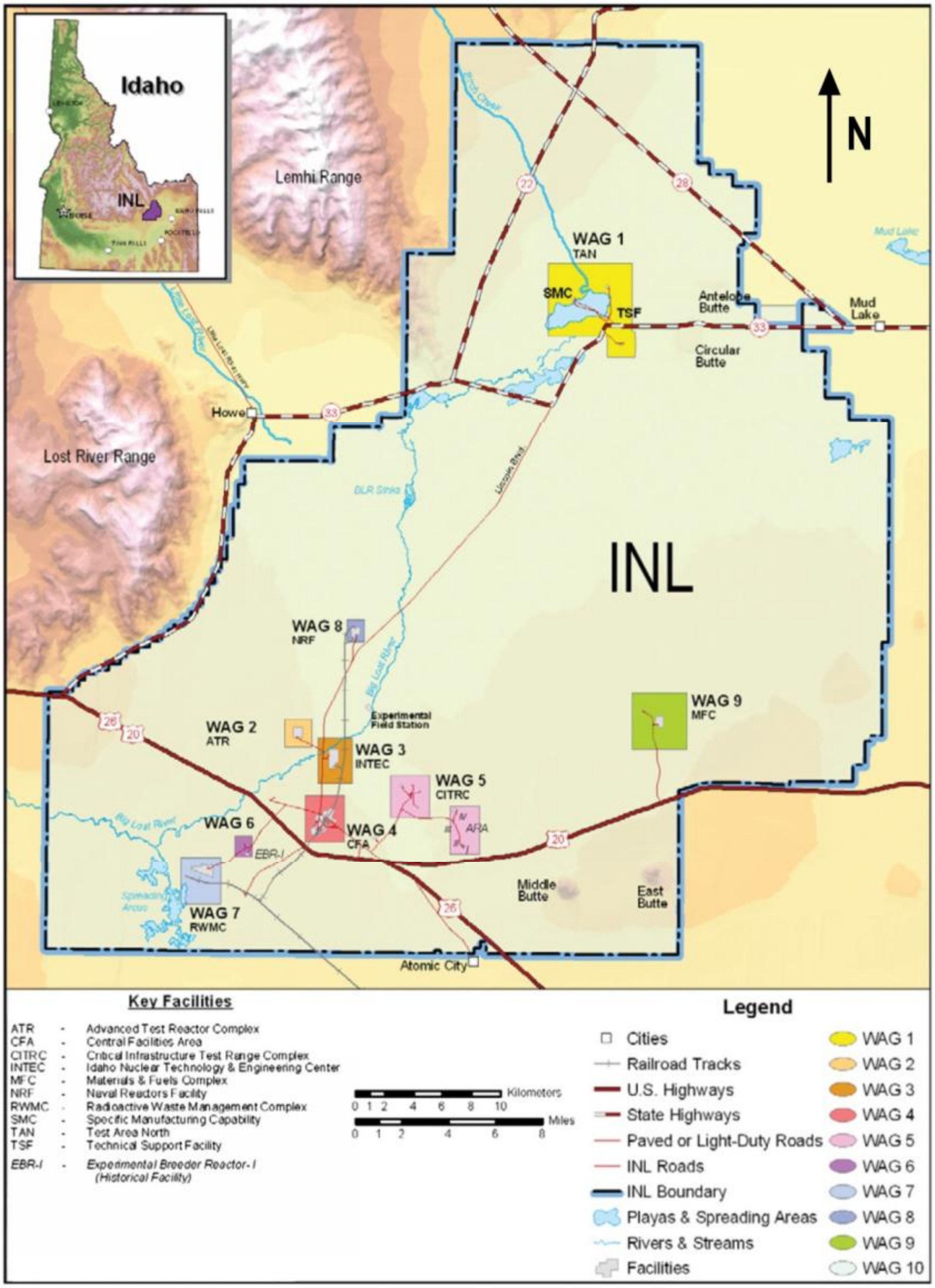
Source: ESER 2009

Figure 3.4-9: INL Groundwater Monitoring Locations



Source: ESER 2009

Figure 3.4-10: INL Facility Groundwater Monitoring Locations

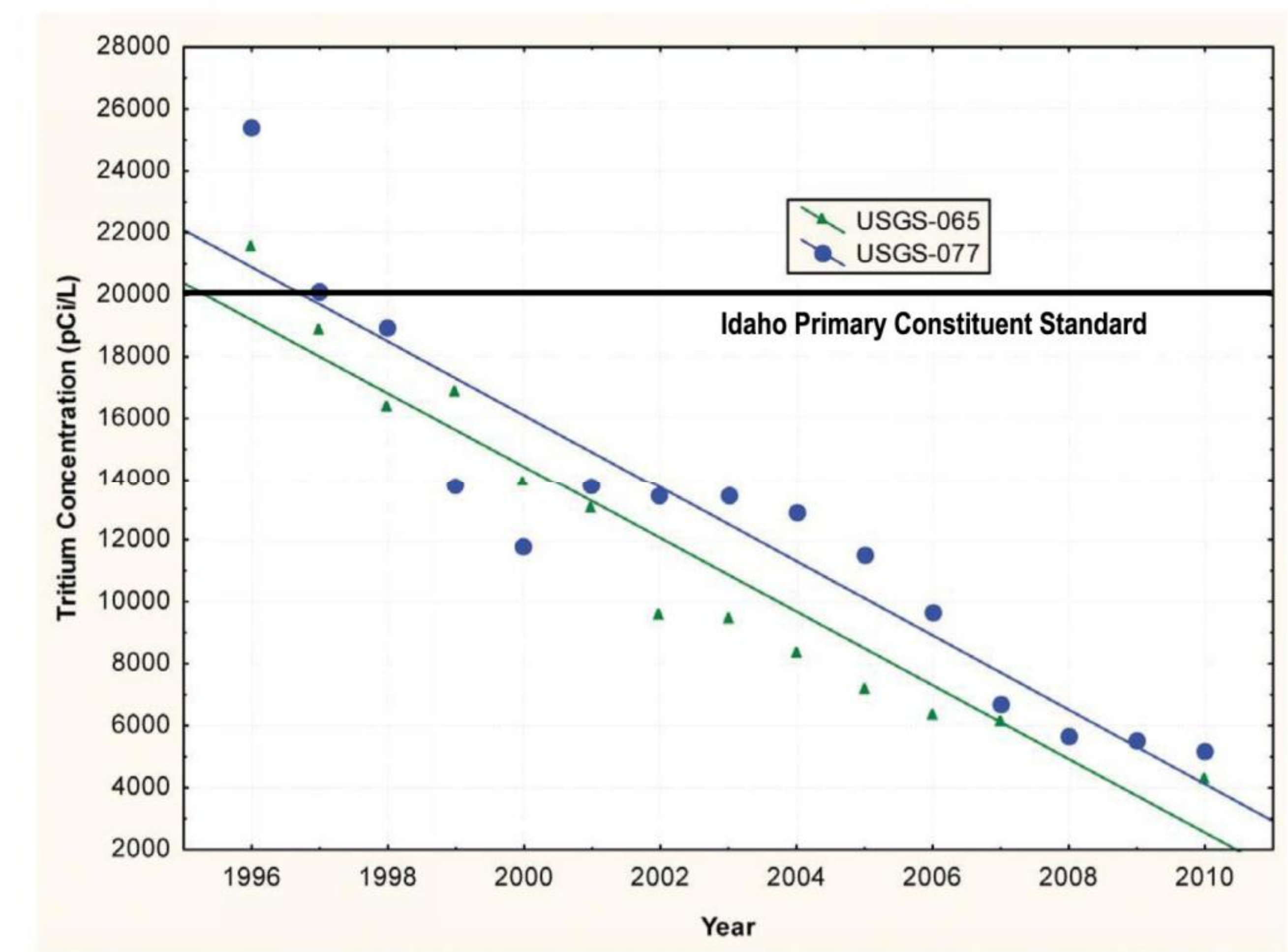


Source: ESER 2010

Figure 3.4-11: INL Facility Locations and Corresponding WAGs

INL Groundwater Quality

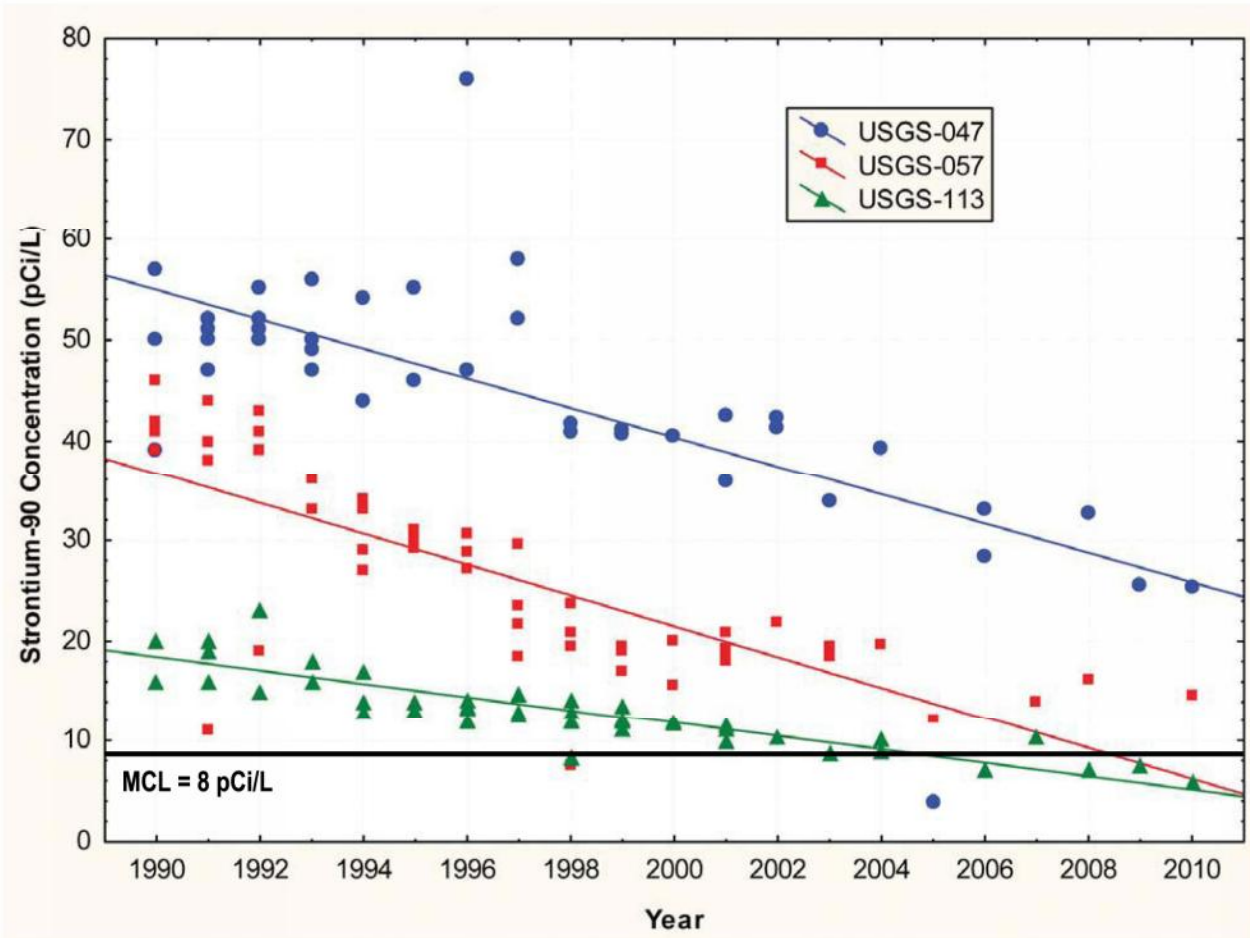
Localized areas of radiochemical and chemical contamination are present in the SRPA beneath INL. These areas, or plumes, are considered to be the result of past disposal practices. Of principal concern at INL over the years have been the movements of the ^{3}H, and ^{90}Sr plumes. ^{129}I has also been a concern. Groundwater monitoring has generally shown long-term trends of decreasing concentrations for these radionuclides and current concentrations are near or below EPA MCLs for drinking water (ESER 2010) (Figures 3.4-12 and 3.4-13). The decreases in concentrations are attributed to discontinued disposal to the aquifer, radioactive decay, and dilution within the aquifer.



Source: ESER 2010

Note: USGS 065 is downgradient of ATR Complex. USGS 077 is downgradient of INTEC.

Figure 3.4-12: Long-Term Trend of Tritium in USGS Wells (1995 – 2010)



Source: ESER 2010

Note: Wells are downgradient of INTEC.

Figure 3.4-13: Long-Term Trend of Strontium-90 in USGS Wells (1990-2010)

USGS collects samples annually from select wells at INL for gross alpha, gross beta, gamma spectroscopy analyses, and plutonium and americium isotopes (ESER 2011). Between 2006 and 2008, concentrations of ^{137}Cs, plutonium-238 (^{238}Pu), plutonium-239/240 (^{239}Pu/^{240}Pu), and americium-241 (^{241}Am) in all samples analyzed were less than the reporting level. Prior to 2008, gross alpha-particle radioactivity in 58 wells was less than the reporting level. In 2008, sensitivity of analyses and changing the radionuclide reported for gross alpha activity resulted in reportable concentrations in 24 of the 58 wells and ranged from 2.3 (±0.7) to 6.6 (±1.3) picocuries per liter (ESER 2011). In 2008, concentrations of gross-beta particle radioactivity exceeded the reporting level in 37 of 58 wells sampled, and concentrations ranged from 2.8 (±0.9) to 21.6 (±1.8) picocuries per liter.

USGS also collects samples annually from selected wells at INL for chloride, sulfate, sodium, fluoride, nitrate, chromium, selected other trace elements, total organic carbon, and purgeable (volatile) organic compounds (ESER 2011). Chromium had a concentration at the MCL of 100 micrograms per liter in Well USGS-065 in 2005 and 2009; its concentration dropped to 85 micrograms per liter in 2010. Concentrations of chloride, nitrate, sodium, and sulfate historically have been above background concentrations in many wells at INL, but concentrations were below established MCLs or secondary MCLs in all wells during 2008 (ESER 2011).

In 2010, samples from 30 groundwater monitoring wells were analyzed for 61 purgeable organic compounds (ESER 2011). In at least one well on INL, seven purgeable organic compounds were detected above the MDL of 0.2 or 0.1 micrograms per liter (depending on the compound) (Table 3.4-4). With the exception of tetrachloromethane in the production well at the RWMC, organic compound concentrations were below regulatory limits. Concentrations of tetrachloromethane at the RWMC production well exceeded the EPA MCL of 5 micrograms per liter in all 12 months of 2010, and ranged from 5.58 to 9.87 micrograms per liter.

Table 3.4-4: Purgeable Organic Compounds in USGS Wells Sampled in 2010

Constituent	USGS 065	USGS 087	USGS 088	USGS 120
	micrograms per liter			
Tetrachloromethane (MCL[1] = 5)	ND[2]	4.67	0.523	0.691
Trichloromethane No standard established	ND	0.285	0.378	ND
1,1,1-Trichlorethane (PCS[3] = 200)	0.111	0.179	ND	ND
Tetrachloroethene (MCL = 5)	ND	0.113	ND	ND
Dichloro-difluoromethane No standard established	ND	1.87	ND	ND
Styrene (MCL=100)	ND	0.167	ND	ND
Trichloroethene (PCS = 5)	ND	0.637	0.378	ND

[1]MCL = maximum contaminant level from EPA in micrograms per liter (40 C.F.R. § 141)
[2]ND = not detected
[3]PCS = primary constituent standard values from IDAPA 58.01.11

NRF Groundwater Monitoring Network

NRF manages a comprehensive groundwater monitoring program under CERCLA to determine what, if any, effects the operations at NRF have had on the quality of the groundwater. This monitoring program, which is conducted in cooperation with the USGS, indicates that NRF operations have not significantly degraded the quality of the groundwater. NRF data, in conjunction with other INL groundwater data, are also used in an independent program managed by the USGS that monitors groundwater on INL. The INL Oversight Program co-samples NRF and other INL groundwater monitoring wells on a periodic basis to verify programmatic monitoring results.

In addition, the USGS and the INL Oversight Program perform independent groundwater sampling off of INL to ensure that INL operations, including NRF, do not adversely impact the general public or the water quality of the SRPA. Results of these monitoring programs indicate that no hazardous constituents or significant radioactivity associated with INL operations are migrating beyond the INL boundary. This monitoring provides an additional confirmation that there is no adverse impact on the aquifer from NRF operations.

The wastewater reuse permit requires NRF to collect groundwater data to monitor activities associated with the operation of the IWD. The groundwater monitoring network for CERCLA WAG 8 overlaps with that of the permit network, and includes four additional wells (NRF-7, USGS 97, USGS 98, and USGS 99, Figure 3.4-14).

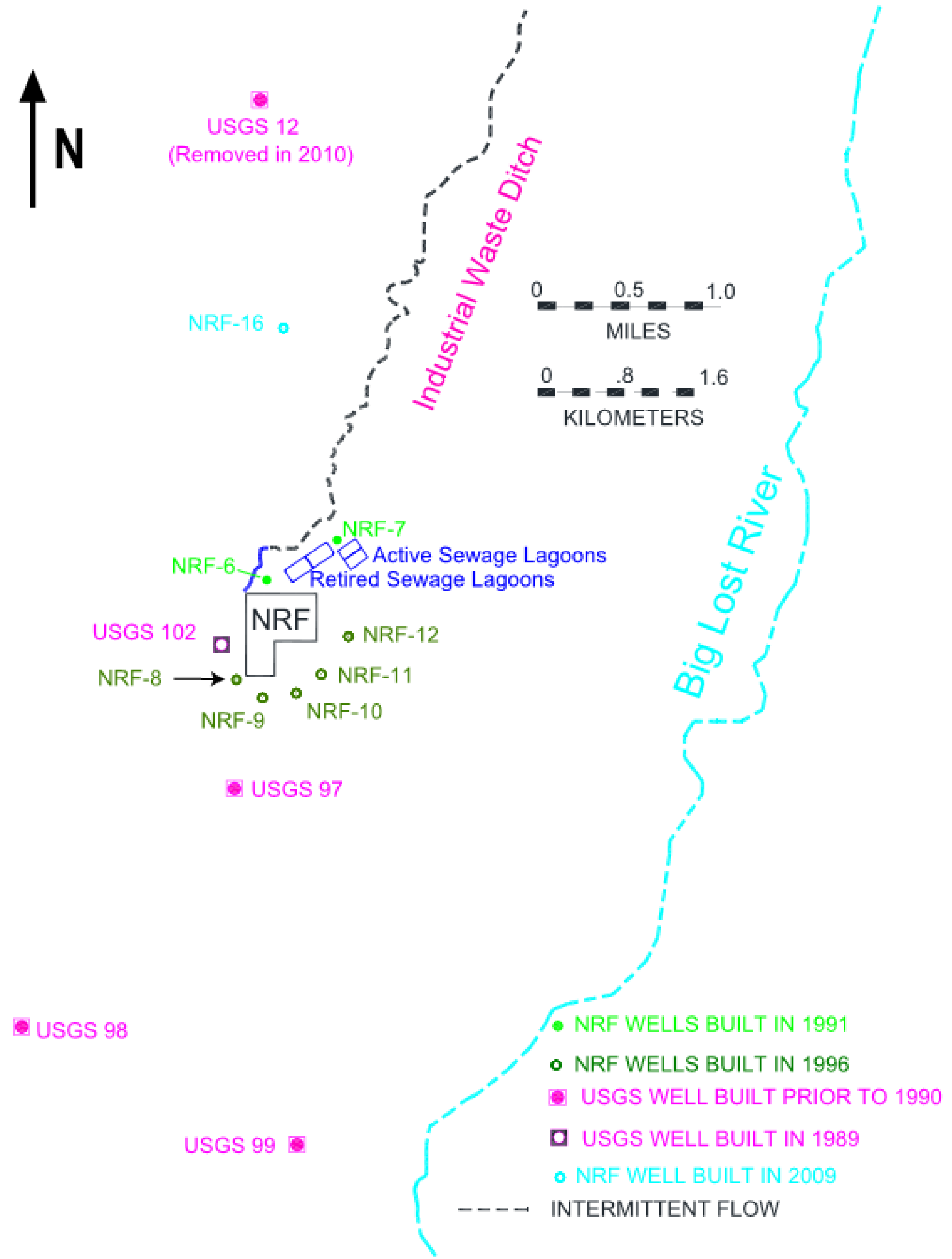


Figure 3.4-14: Location of NRF IWD and WAG 8 Groundwater Monitoring Wells

NRF monitoring wells are placed into one of four groups to facilitate evaluation of groundwater data (Table 3.4-5). These include the Regional Upgradient Well Group representing upgradient background water quality; Local Downgradient and Regional Downgradient Well Groups representing downgradient water quality, and the Effluent System Well Group representing water quality associated with discharges to the IWD.

Table 3.4-5: Well Groups Used in Groundwater Monitoring Analysis

Well Group	Wells
Regional Upgradient	USGS 12[1], NRF-7[1]
Regional Downgradient	USGS 97, USGS 98, USGS 99
Effluent System	NRF-6
Local Downgradient	USGS 102, NRF-8, NRF-9, NRF-10, NRF-11, NRF-12
[1]Replaced by NRF-16 in 2010. For the purposes of this EIS, and because of limited amount of data available from NRF-16, they were used as a data source for Regional Upgradient Wells.	

NRF Groundwater Quality

In 2012, a groundwater analysis was conducted to compare long-term monitoring results to federal drinking water guidelines and to local background concentrations to determine NRF impacts on groundwater quality. The analysis covered the period from inclusion of wells in the groundwater monitoring network (1989, 1991, or 1996, depending on the well) through November 2010. Detailed analysis methods are available in BMPC 2012. Results for inorganic, organic, and radiological constituents in NRF groundwater are summarized below.

For purposes of the groundwater analysis, several key constituents were considered (Table 3.4-6). Key constituents included in the assessment were based on the following criteria:

- Contaminants of concern that are routinely measured.
- Constituents detected in the soil during confirmation sample analysis that were also consistently detected in groundwater samples and were known to have been released at NRF in the past. These constituents include chromium.
- Constituents that are good geochemical indicators. This group includes calcium, chloride, sodium, and tritium. These constituents generally do not interact with the aquifer matrix material, and therefore reflect important aquifer properties such as dispersion and groundwater flow paths.
- Constituents that are consistently present in NRF groundwater samples and act as geochemical indicators. This group includes aluminum, iron, manganese, and nickel. These constituents may interact with the aquifer matrix.

The mean concentrations for each well and well group for all NRF inorganic groundwater constituents are compared to background concentrations and EPA MCLs in Table 3.4-6. None of the constituent concentrations exceeded primary EPA MCLs, and with the exception of iron in two wells (NRF-6 and NRF-7) and chloride in one well (NRF-6), none of the mean concentrations exceeded secondary federal MCLs.

NRF-6 is located immediately downgradient of the IWD; therefore, sample results from this well reflect contributions from the IWD effluent. NRF-7 is a low-producing well (3.8 to 11.4 liters (1 to 3 gallons) per minute), that produces results that sometimes can be influenced by the presence of fine sediments, hence the elevated iron results.

The values in Table 3.4-6 are color coded with respect to regional upgradient concentrations. Specific conductance and ionic salt constituents including calcium, chloride, magnesium, potassium, sodium and sulfate in NRF-6 and other wells were elevated by greater than three standard deviations compared to upgradient concentrations. The causes for these observations are discussed below.

Sodium chloride is used to create the regeneration solution for current water softening processes at NRF. As a result of the softening cycle, the solution discharged to the IWD contains elevated levels of calcium, chloride, magnesium, and sodium ions compared to upgradient (background) groundwater. These elevated concentrations of calcium, chloride, magnesium, and sodium ions are reflected in the groundwater after the IWD effluent percolates through the ground to the aquifer below. The elevated concentration of potassium ions in the aquifer is likely due to exchange reactions occurring between calcium ions and magnesium ion-rich IWD effluent as it percolates through sediments and rocks to the aquifer below. In this process, IWD effluent (now groundwater recharge) is slightly enriched in potassium ions while the surrounding aquifer material is enriched in calcium and magnesium ions.

Prior to the mid-1990s, NRF used sulfuric acid as the regeneration solution for the water softening process such that elevated levels of neutralized sulfate ion-rich wastewater was discharged to the IWD. This resulted in the perched water located below the IWD containing a sulfate ion concentration in excess of 350 milligrams per liter. The concentration of sulfate ions that is currently present in perched water beneath the IWD is believed to still contain elevated levels of residual sulfate ions. The fact that the concentration of sulfate ions currently in NRF-6 water samples is higher than the concentration being discharged to the IWD suggests that water containing elevated concentrations of sulfate ions is slowly being released as perched water drains to the aquifer below. The concentration of sulfate ions in NRF-6 water samples is less than the MCL.

Downgradient wells USGS 97, USGS 98, and USGS 99 contain zinc concentrations that are elevated compared to background but are significantly below the MCL. Zinc levels in these wells are associated with well construction issues rather than groundwater issues. This conclusion is supported by the observation that the mean zinc concentration in USGS 98 was approximately 150 parts per billion prior to the replacement of the pump, motor, and well screen in this well early in 2005 compared to a mean of approximately 11 parts per billion after the refurbishment. Well components and construction history for USGS 97 and USGS 99 are similar to that of USGS 98.

The presence of elevated nitrate levels in most of the downgradient wells indicates the influence of the NRF retired sewage lagoons. These retired sewage lagoons are nearly 50 years old and are known to leak. All nitrate concentrations are significantly below primary MCLs.

The average concentration of chromium in NRF-6 exceeded the upgradient concentration by a factor of approximately four, but was well below the MCL.

Table 3.4-6: Comparison of MCL and Background Groundwater Concentrations to Individual Wells and Well Groups

Constituent	pH	Specific Conductance	Aluminum	Antimony	Arsenic	Barium	Beryllium
		microsiemen/ centimeter	parts per billion				
MCL	6.5 to 8.5 (a)	NA	200 (a)	6	10	2000	4
Background	8.0 ± 0.2	397 ± 11	63 ± 43	0.44 ± 0.31	3.0 ± 1.4	101 ± 21	0.9 ± 0.7
NRF-6	7.8 ± 0.2	1589 ± 350	52 ± 37	0.49 ± 0.47	4.2 ± 0.9	106 ± 39	0.9 ± 0.7
NRF-7	8.3 ± 0.2	246 ± 9	114 ± 97	0.44 ± 0.35	3.1 ± 1.5	70 ± 21	0.9 ± 0.7
NRF-8	7.8 ± 0.2	569 ± 19	51 ± 39	0.48 ± 0.84	3.3 ± 1.5	127 ± 8	0.9 ± 0.7
NRF-9	7.8 ± 0.2	615 ± 19	58 ± 38	0.51 ± 1.02	3.3 ± 1.5	137 ± 7	0.9 ± 0.7
NRF-10	7.8 ± 0.2	582 ± 22	140 ± 102	0.63 ± 1.35	3.5 ± 1.7	136 ± 8	0.9 ± 0.7
NRF-11	7.8 ± 0.2	603 ± 24	55 ± 35	0.46 ± 0.75	4.9 ± 3.0	138 ± 15	0.9 ± 0.6
NRF-12	7.8 ± 0.2	624 ± 51	56 ± 37	0.40 ± 0.51	3.3 ± 1.5	149 ± 14	0.9 ± 0.6
USGS 12	7.8 ± 0.1	545 ± 43	49 ± 41	0.43 ± 0.33	3.0 ± 1.4	129 ± 18	0.9 ± 0.6
USGS 97	7.9 ± 0.1	584 ± 18	54 ± 39	0.49 ± 0.56	2.9 ± 1.4	127 ± 16	0.9 ± 0.6
USGS 98	7.9 ± 0.1	415 ± 21	54 ± 37	0.41 ± 0.35	2.9 ± 1.5	51 ± 8	0.9 ± 0.7
USGS 99	7.9 ± 0.1	526 ± 13	51 ± 42	0.41 ± 0.35	4.1 ± 3.2	105 ± 6	0.9 ± 0.7
USGS 102	7.9 ± 0.1	568 ± 20	48 ± 36	0.41 ± 0.34	2.9 ± 1.4	114 ± 10	0.9 ± 0.6
Regional Upgradient[1]	8.0 ± 0.3	404 ± 153	79 ± 79	0.44 ± 0.34	3.0 ± 1.4	101 ± 36	0.9 ± 0.6
Effluent System[2]	7.8 ± 0.2	1589 ± 350	52 ± 37	0.49 ± 0.47	4.2 ± 0.9	106 ± 39	0.9 ± 0.7
Local Downgradient[3]	7.8 ± 0.2	591 ± 35	66 ± 60	0.48 ± 0.86	3.6 ± 2.0	133 ± 15	0.9 ± 0.6
RegionalDowngradient[4]	7.9 ± 0.1	509 ± 72	53 ± 39	0.44 ± 0.43	3.4 ± 2.4	97 ± 32	0.9 ± 0.6

(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)	(orange)	Between 1 and 2 standard deviations greater than background
(b) Action Level	(green)	Between 2 and 3 standard deviations greater than background
NA=MCL not determined	(blue)	Greater than 3 standard deviations from background

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through NRF-12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97, USGS 98, and USGS 99

Notes: Table constituents are arranged by metals, salts, nutrients, and then radionuclides.
Averages are for 1989-2010 for wells USGS 12, 97, 98, 99, and 102; 1991-2010 for NRF-6 and NRF-7; and 1996-2010 for NRF-8, 9, 10, 11, and 12.
Specific conductance is a measure of the ionic content of a water sample (e.g., salinity).

Table 3.4-6: Comparison of MCL and Background Groundwater Concentrations to Individual Wells and Well Groups (cont.)

Constituent	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury
	parts per billion						
MCL	5	100	1000 (a)	300 (a)	15 (b)	50 (a)	2
Background	0.5 ± 0.4	9 ± 3	3 ± 2	138 ± 171	1.8 ± 0.9	6 ± 5	0.1 ± 0.0
NRF-6	0.5 ± 0.3	34 ± 9	3 ± 2	465 ± 474	1.8 ± 0.9	6 ± 4	0.1 ± 0.1
NRF-7	0.4 ± 0.4	12 ± 2	4 ± 4	310 ± 293	1.8 ± 1.0	8 ± 6	0.1 ± 0.1
NRF-8	0.4 ± 0.2	8 ± 1	4 ± 3	69 ± 44	2.1 ± 1.0	3 ± 4	0.1 ± 0.1
NRF-9	0.4 ± 0.2	11 ± 1	3 ± 3	78 ± 43	2.0 ± 0.9	4 ± 4	0.1 ± 0.1
NRF-10	0.4 ± 0.2	14 ± 3	3 ± 3	236 ± 215	2.1 ± 0.9	6 ± 4	0.1 ± 0.1
NRF-11	0.5 ± 0.2	17 ± 4	4 ± 3	79 ± 53	2.0 ± 0.9	4 ± 4	0.1 ± 0.1
NRF-12	0.4 ± 0.2	18 ± 4	4 ± 3	86 ± 54	2.0 ± 0.9	4 ± 4	0.1 ± 0.1
USGS 12	0.5 ± 0.3	7 ± 1	2 ± 1	59 ± 42	1.7 ± 0.9	5 ± 5	0.1 ± 0.1
USGS 97	0.6 ± 0.3	7 ± 1	3 ± 2	66 ± 55	2.2 ± 0.9	6 ± 5	0.1 ± 0.1
USGS 98	0.5 ± 0.3	6 ± 1	3 ± 2	131 ± 110	3.9 ± 2.4	7 ± 4	0.1 ± 0.1
USGS 99	0.6 ± 0.3	6 ± 1	3 ± 1	109 ± 89	2.2 ± 0.9	5 ± 5	0.1 ± 0.1
USGS 102	0.5 ± 0.3	7 ± 1	3 ± 3	86 ± 91	1.7 ± 0.9	5 ± 5	0.1 ± 0.1
Regional Upgradient[1]	0.5 ± 0.3	9 ± 3	3 ± 3	179 ± 239	1.8 ± 0.9	7 ± 5	0.1 ± 0.1
Effluent System[2]	0.5 ± 0.3	34 ± 9	3 ± 2	465 ± 474	1.8 ± 0.9	6 ± 4	0.1 ± 0.1
Local Downgradient[3]	0.5 ± 0.2	12 ± 5	3 ± 3	104 ± 116	2.0 ± 0.9	4 ± 4	0.1 ± 0.1
Regional Downgradient[4]	0.5 ± 0.3	6 ± 1	3 ± 2	102 ± 91	2.8 ± 1.8	6 ± 5	0.1 ± 0.1
(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)				(orange)	Between 1 and 2 standard deviations greater than background		
(b) Action Level				(green)	Between 2 and 3 standard deviations greater than background		
NA=MCL not determined				(blue)	Greater than 3 standard deviations from background		

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through NRF-12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97, USGS 98, and USGS 99

Notes: Table constituents are arranged by metals, salts, nutrients, and then radionuclides.
Averages are for 1989-2010 for wells USGS 12, 97, 98, 99, and 102; 1991-2010 for NRF-6 and NRF-7; and 1996-2010 for NRF-8, 9, 10, 11, and 12.

Table 3.4-6: Comparison of MCL and Background Groundwater Concentrations to Individual Wells and Well Groups (cont.)

Constituent	Nickel	Selenium	Silver	Thallium	Zinc	Calcium	Potassium
	parts per billion						
MCL	NA	50	100 (a)	2	5000 (a)	NA	NA
Background	5.9 ± 2.7	4 ± 2	1.1 ± 0.3	0.15 ± 0.2	12.0 ± 8	44210 ± 2530	2583 ± 199
NRF-6	11.5 ± 7.8	4 ± 1	1.0 ± 0.7	0.39 ± 1.4	12.0 ± 8	130144 ± 25441	5208 ± 1009
NRF-7	8.3 ± 3.5	4 ± 2	1.1 ± 0.7	0.14 ± 0.2	13 ± 9	26174 ± 2807	3067 ± 276
NRF-8	4.5 ± 3.3	5 ± 0	1.1 ± 0.9	0.11 ± 0.2	11 ± 7	68267 ± 3936	2291 ± 185
NRF-9	4.3 ± 3.4	5 ± 1	1.1 ± 0.9	0.11 ± 0.2	12 ± 7	72273 ± 4184	2485 ± 265
NRF-10	12.4 ± 8.3	5 ± 1	1.1 ± 0.9	0.10 ± 0.1	11 ± 8	68254 ± 4516	2497 ± 206
NRF-11	7.1 ± 2.8	5 ± 1	1.2 ± 0.9	0.26 ± 0.9	12 ± 7	69423 ± 4384	2541 ± 223
NRF-12	8.0 ± 5.9	4 ± 1	1.1 ± 0.9	0.10 ± 0.2	12 ± 7	70717 ± 5903	2582 ± 231
USGS 12	3.2 ± 3.1	4 ± 1	0.8 ± 0.2	0.15 ± 0.2	12 ± 6	62135 ± 5418	2037 ± 226
USGS 97	3.2 ± 3.1	4 ± 1	1.1 ± 0.7	0.18 ± 0.2	5 ± 1	68104 ± 4347	2157 ± 234
USGS 98	2.9 ± 3.1	4 ± 2	1.1 ± 0.7	0.16 ± 0.2	11 ± 4	47452 ± 3701	2142 ± 233
USGS 99	3.1 ± 3.0	4 ± 2	1.1 ± 0.7	0.14 ± 0.2	113 ± 26	61586 ± 3093	1818 ± 185
USGS 102	3.1 ± 3.0	4 ± 1	1.1 ± 0.8	0.13 ± 0.2	13 ± 8	67814 ± 4491	2228 ± 233
Regional Upgradient[1]	5.8 ± 4.2	4 ± 2	0.9 ± 0.5	0.15 ± 0.2	12 ± 8	44722 ± 18579	2546 ± 575
Effluent System[2]	11.5 ± 7.8	4 ± 1	1.0 ± 0.7	0.39 ± 1.4	12 ± 8	130144 ± 25441	5208 ± 1009
Local Downgradient[3]	6.5 ± 5.8	4 ± 1	1.1 ± 0.9	0.14 ± 0.4	12 ± 7	69456 ± 4836	2437 ± 259
Regional Downgradient[4]	3.1 ± 3.0	4 ± 2	1.1 ± 0.7	0.16 ± 0.2	81 ± 53	59002 ± 9385	2037 ± 268

(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)	(orange)	Between 1 and 2 standard deviations greater than background
(b) Action Level	(green)	Between 2 and 3 standard deviations greater than background
NA=MCL not determined	(blue)	Greater than 3 standard deviations from background

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through NRF -12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97, USGS 98, and USGS 99

Notes: Table constituents are arranged by metals, salts, nutrients, and then radionuclides.
Averages are for 1989-2010 for wells USGS 12, 97, 98, 99, and 102; 1991-2010 for NRF-6 and NRF -7; and 1996-2010 for NRF-8, 9, 10, 11, and 12.

Table 3.4-6: Comparison of MCL and Background Groundwater Concentrations to Individual Wells and Well Groups (cont.)

Constituent	Magnesium	Sodium	Chloride	Sulfate	NO_2	$NO_2 + NO_3$	^{90}Sr
	parts per billion						picocuries per liter
MCL	NA	NA	250000 (a)	250000 (a)	1000	10000	8
Background	14614 ± 382	11659 ± 1056	17152 ± 548	22766 ± 3511	3 ± 1	1115 ± 72	0.09 ± 0.11
NRF-6	34431 ± 5190	123192 ± 47366	301485 ± 133391	150094 ± 61593	3 ± 2	1834 ± 173	0.11 ± 0.18
NRF-7	9213 ± 447	8962 ± 780	5017 ± 283	13967 ± 776	3 ± 1	464 ± 45	0.10 ± 0.15
NRF-8	21923 ± 1411	15307 ± 987	32902 ± 3352	33431 ± 1984	3 ± 2	1913 ± 210	0.10 ± 0.16
NRF-9	22496 ± 1334	18187 ± 1281	44702 ± 3965	42188 ± 3793	3 ± 2	2183 ± 180	0.12 ± 0.18
NRF-10	21953 ± 1551	15773 ± 1543	41951 ± 3787	38898 ± 3286	4 ± 2	1802 ± 170	0.07 ± 0.11
NRF-11	21883 ± 1381	18779 ± 1564	43117 ± 3878	40349 ± 3756	4 ± 3	1923 ± 213	0.07 ± 0.10
NRF-12	22138 ± 2076	20177 ± 2516	48243 ± 9025	45672 ± 8886	4 ± 3	1893 ± 221	0.09 ± 0.17
USGS 12	19829 ± 1832	14251 ± 2189	28074 ± 8992	30444 ± 5029	3 ± 2	1672 ± 406	0.06 ± 0.12
USGS 97	22308 ± 1451	15181 ± 1791	33189 ± 2742	34283 ± 1898	3 ± 2	2012 ± 162	0.08 ± 0.17
USGS 98	18198 ± 1463	9915 ± 1123	14369 ± 777	21533 ± 822	3 ± 1	1124 ± 120	0.03 ± 0.12
USGS 99	21652 ± 907	14023 ± 1677	22008 ± 1899	26854 ± 1428	3 ± 1	1683 ± 145	0.05 ± 0.15
USGS 102	21671 ± 1467	14443 ± 1635	31880 ± 2948	33286 ± 2322	3 ± 3	1892 ± 174	0.09 ± 0.11
Regional Upgradient[1]	14746 ± 5500	11742 ± 3133	17485 ± 13285	22747 ± 9041	3 ± 2	1118 ± 674	0.08 ± 0.13
Effluent System[2]	34431 ± 5190	123192 ± 47366	301485 ± 133391	150094 ± 61593	3 ± 2	1834 ± 173	0.11 ± 0.18
Local Downgradient[3]	22009 ± 1562	16914 ± 2683	39822 ± 7847	38520 ± 6360	3 ± 3	1929 ± 223	0.09 ± 0.14
Regional Downgradient[4]	20737 ± 2217	13078 ± 2739	23528 ± 7950	27880 ± 5390	3 ± 1	1608 ± 392	0.06 ± 0.15
(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)				(orange)	Between 1 and 2 standard deviations greater than background		
(b) Action Level				(green)	Between 2 and 3 standard deviations greater than background		
NA=MCL not determined				(blue)	Greater than 3 standard deviations from background		

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through NRF-12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97, USGS 98, and USGS 99

Notes: Table constituents are arranged by metals, salts, nutrients, and then radionuclides.
Averages are for 1989-2010 for wells USGS 12, 97, 98, 99, and 102; 1991-2010 for NRF-6 and NRF-7; and 1996-2010 for NRF-8, 9, 10, 11, and 12.

Table 3.4-6: Comparison of MCL and Background Groundwater Concentrations to Individual Wells and Well Groups (cont.)

Constituent	^{63}Ni	^{137}Cs	^{60}Co	^{3}H (Historical)	^{3}H (5-year, 2005-2010)
	picocuries per liter				
MCL	50	200	100	20000	20000
Background	0.31 ± 0.74	0.14 ± 0.34	0.44 ± 1.28	26.56 ± 16.20	26.56 ± 16.20
NRF-6	0.17 ± 1.13	0.17 ± 0.53	0.01 ± 0.91	60.20 ± 19.30	40.66 ± 9.11
NRF-7	0.22 ± 0.87	0.08 ± 0.39	0.23 ± 0.42	2.67 ± 2.99	2.56 ± 3.11
NRF-8	0.39 ± 0.69	0.08 ± 0.43	-0.66 ± 1.07	44.45 ± 10.50	35.48 ± 8.81
NRF-9	0.34 ± 0.85	0.10 ± 0.54	-0.10 ± 0.44	79.37 ± 27.52	48.98 ± 14.88
NRF-10	4.08 ± 2.01	0.10 ± 0.41	-0.05 ± 0.96	109.49 ± 33.87	72.08 ± 16.62
NRF-11	1.89 ± 0.95	0.07 ± 0.33	0.23 ± 0.29	139.27 ± 86.55	42.87 ± 13.17
NRF-12	-0.10 ± 0.39	0.22 ± 0.41	-0.14 ± 1.13	49.66 ± 14.67	32.26 ± 8.30
USGS 12	0.39 ± 0.60	0.17 ± 0.33	-0.10 ± 0.91	49.67 ± 16.03	31.27 ± 7.21
USGS 97	-0.18 ± 1.01	0.10 ± 0.35	-0.44 ± 1.28	43.04 ±12.38	28.76 ± 6.82
USGS 98	0.34 ± 0.66	-0.07 ± 0.27	0.00 ± 0.22	15.20 ± 6.43	10.10 ± 4.99
USGS 99	0.64 ± 1.03	0.05 ± 0.32	0.86 ± 1.03	26.93 ± 8.12	21.83 ± 12.92
USGS 102	0.14 ± 0.52	0.30 ± 0.60	0.39 ± 2.26	45.51 ± 13.16	33.54 ± 10.84
Regional Upgradient[1]	0.30 ± 0.74	0.12 ± 0.36	0.07 ± 0.71	28.50 ± 26.40	18.35 ± 15.69
Effluent System[2]	0.17 ± 1.13	0.17 ± 0.53	0.01 ± 0.91	60.20 ± 19.30	40.66 ± 9.11
Local Downgradient[3]	1.26 ± 1.87	0.15 ± 0.47	-0.04 ± 1.22	77.80 ± 54.24	44.20 ± 18.32
Regional Downgradient[4]	0.28 ± 0.96	0.03 ± 0.32	0.17 ± 1.14	28.27 ± 14.62	19.09 ± 9.77

(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)	(orange)	Between 1 and 2 standard deviations greater than background
(b) Action Level	(green)	Between 2 and 3 standard deviations greater than background
NA=MCL not determined	(blue)	Greater than 3 standard deviations from background

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97, USGS 98, and USGS 99

Notes: Table constituents are arranged by metals, salts, nutrients, and then radionuclides.
Unless otherwise noted, averages are for 1989-2010 for wells USGS 12, 97, 98, 99, and 102; 1991-2010 for NRF-6 and NRF-7; and 1996-2010 for NRF-8, 9, 10, 11, and 12.
For concentrations of radiological constituents, values can be negative if the statistical count for the sample is less the background concentration used in the analysis.

Table 3.4-6 shows ^3H averages since the collection of data began (historical) and the ^3H averages for the period from 2005 to 2010. The historical levels of ^3H in NRF-9, NRF-10, and NRF-11 (wells in the Local Downgradient Well Group) were elevated with respect to background, although significantly lower than the MCL. These wells are located downgradient of the S1W Leaching Beds/Pit. Residual contamination from historical ^3H releases from the deactivated S1W prototype is the suspected source. Because of these three wells, the historical average in the Local Downgradient Group is also elevated. The 5-year ^3H averages for NRF-9, NRF-10, and NRF-11 are significantly lower than their historical counterparts and are only slightly above background concentrations reflecting the results of the natural decay of the ^3H.

The historical levels of ^3H in NRF-6 (Effluent System Well Group) were slightly elevated above background (Table 3.4-6). The source is thought to be historical inadvertent releases to the IWD that are stored in perched water. The residual ^3H is slowly released over time from the perched water zone and detected in the NRF-6 groundwater samples. ^3H concentrations in NRF-6 have declined over time (most likely due to natural decay) and the 5-year average (November 2005 through November 2010) is not significantly different from background. Both the historic and 5-year average ^3H concentrations in NRF-6 are well below the MCL of 20,000 picocuries per liter.

During the 2006 to 2011 period, groundwater samples were analyzed for selected volatile and semi-volatile organic compounds once each year (BMPC 2012). Most of the organic compounds that were evaluated were not detected in NRF water samples, and those that were detected occurred at very low concentrations. Included in this list are bis(2-ethylhexyl)phthalate (related to plastics); butylated hydroxytoluene (a preservative for food and cosmetics); acetone (a laboratory solvent); and benzene, naphthalene and toluene (combustion by-products). Only benzene and toluene have MCLs, and concentrations of these constituents were below the MCLs for all years. Of the remaining compounds detected during 2006 through 2011, only bromacil and tetrachloroethylene were found consistently in NRF-6 samples at low concentrations (Table 3.4-7) and could be related to past operations at NRF.

Tetrachloroethylene concentrations were below the MCL for all years. Bromacil is an herbicide that is used at NRF for weed control. Tetrachloroethylene is a solvent used in industry, and is no longer used at NRF. It is detected as soil vapor from all three abandoned NRF landfills. However, no hydrologic connection between the abandoned landfills and groundwater sampled by NRF-6 is known to exist. The reason for its presence in NRF-6 may be related to IWD discharges from past operations. There is no evidence of a pattern of consistent or wide-spread contamination of the aquifer associated with any organic compound.

Table 3.4-7: Occurrence of Organic Compounds in NRF-6 From 2006 to 2011

	MCL[1]	MDL[2]	NRF-6					
			2006	2007	2008	2009	2010	2011
	parts per billion							
Bromacil	NA	0.1	ND	1.2	0.99	1.2	ND	ND
Tetrachloroethylene	5	0.2	0.28	0.28	0.37	0.35	0.37	ND

[1]Maximum Contaminant Level
[2]Minimum Detection Level
NA = Not Applicable
ND = Not Detected

Table 3.4-8 compares water quality averages between the four well groups for ten key inorganic constituents (four well groups times ten constituents for a total of 40 comparisons) for the periods

1996 through 2000, 2001 through 2005, and 2006 through 2010. These comparisons are intended to provide an overview of trends in constituent concentrations at NRF. Table 3.4-8 shows that group mean concentrations for many of the key constituents have dropped since 1996 (e.g., the Regional Upgradient aluminum concentration of 103 parts per billion compared to a concentration of 39 parts per billion). Of the 40 comparisons made, the mean concentrations for 26 comparisons have declined, seven rose (two only slightly), and seven remained unchanged. With the exception of iron and chloride (secondary MCLs) in the Effluent System Well Group for two of the time periods, mean constituent concentrations were below MCLs.

Where increases were noted, they were relatively small with the exception of calcium, chromium, sodium, and chloride in the Effluent System Well Group. The increase in the ionic salt concentrations is primarily due to water softening operations at NRF as discussed above coupled with a decrease in the volume of water discharged to the IWD from other sources which are not associated with water softening operations.

In summary, Table 3.4-8 shows that the relative magnitude of mean constituent concentrations is nearly the same (or slightly lower) compared to those described in the 2001 NRF Five-Year CERCLA Review (BBI 2001) and supports the conclusion that past or present operations at NRF do not substantially impact the quality of the SRPA. Table 3.4-8 also shows that the average activity levels for ^{3}H in all wells is lower over the past 5 years compared to historical averages demonstrating the effects of radioactive decay.

The 2006 to 2010 Local Downgradient Group average is lower in concentration for nine of the ten key constituents compared to the 1996 to 2000 Local Downgradient Group average for the same constituents. The only exception is sodium. These observations suggests that water quality downgradient of NRF is generally improving.

Data derived from individual NRF groundwater monitoring wells contained within the various groups for ten selected key constituents (discussed above) were evaluated for trends. This evaluation shows that a majority of the key constituents are stable or trending downward in the individual NRF groundwater monitoring wells. See BMPC 2012 for discussion on trends in individual wells and in-depth analysis on trends in chloride, chromium, and ^{3}H. Overall, most measured contaminants are trending downward. Samples representing regional upgradient and regional downgradient water quality are statistically similar, thus, indicating that past and present operations at NRF have had no significant impact on groundwater quality.

Table 3.4-8: Comparison of MCL and NRF Background Groundwater Concentrations to Individual Wells and Well Groups Over Time

Constituent		Aluminum	Calcium	Chromium	Iron	Manganese
		parts per billion				
MCL		200 (a)	NA	100	300 (a)	50 (a)
2006 to 2010	Regional Upgradient[1]	39 ± 33	43955 ± 19810	10 ± 2	97 ± 75	3 ± 2
	Effluent System[2]	19 ± 4	153939 ± 13810	43 ± 8	73 ± 40	1 ± 1
	Local Downgradient[3]	35 ± 43	68606 ± 3666	12 ± 3	63 ± 84	2 ± 2
	Regional Downgradient[4]	23 ± 14	56438 ± 10519	7 ± 1	92 ± 117	3 ± 3
2001 to 2005	Regional Upgradient[1]	68 ± 56	45448 ± 18212	9 ± 3	186 ± 320	4 ± 4
	Effluent System[2]	69 ± 34	131329 ± 25103	31 ± 8	566 ± 479	5 ± 4
	Local Downgradient[3]	79 ± 79	66768 ± 3402	13 ± 6	123 ± 153	3 ± 4
	Regional Downgradient[4]	62 ± 35	59014 ± 8668	6 ± 1	91 ± 84	4 ± 5
1996 to 2000	Regional Upgradient[1]	103 ± 86	44468 ± 18698	9 ± 3	177 ± 210	8 ± 6
	Effluent System[2]	61 ± 39	116050 ± 20782	30 ± 6	646 ± 520	7 ± 3
	Local Downgradient[3]	76 ± 40	72250 ± 4950	12 ± 6	112 ± 92	6 ± 4
	Regional Downgradient[4]	72 ± 41	60769 ± 9093	6 ± 1	92 ± 74	7 ± 4

(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)

NA=MCL not determined

Well Group Configuration

[1]Regional Upgradient Well Group: USGS 12 and NRF-7
[2]Effluent System Well Group: NRF-6
[3]Local Downgradient Well Group: NRF-8 through NRF-12 and USGS 102
[4]Regional Downgradient Well Group: USGS 97,USGS 98, and USGS 99

Table 3.4-8: Comparison of MCL and NRF Background Groundwater Concentrations to Individual Wells and Well Groups Over Time (cont.)

Constituent		Nickel	Sodium	Chloride	Sulfate	Tritium
		parts per billion				picocuries per liter
MCL		NA	NA	250000 (a)	250000 (a)	20000
2006 to 2010	Regional Upgradient[1]	7.2 ± 4.0	12809 ± 3603	17699 ± 13173	23350 ± 9457	26 ± 25
	Effluent System[2]	4.8 ± 2.9	192727 ± 22843	514545 ± 40091	104909 ± 7778	41 ± 14
	Local Downgradient[3]	4.8 ± 2.9	18098 ± 1972	40374 ± 7299	36448 ± 3337	76 ± 46
	Regional Downgradient[4]	4.2 ± 3.3	14639 ± 2567	23306 ± 7358	27521 ± 4974	28 ± 13
2001 to 2005	Regional Upgradient[1]	8.3 ± 5.1	11156 ± 2441	13700 ± 9227	20759 ± 7207	25 ± 24
	Effluent System[2]	9.2 ± 6.3	133335 ± 51918	349647 ± 138921	94118 ± 3878	40 ± 14
	Local Downgradient[3]	6.6 ± 5.1	16823 ± 1911	36822 ± 5780	36259 ± 3943	72 ± 43
	Regional Downgradient[4]	2.8 ± 1.3	13794 ± 2860	23024 ± 6873	27600 ± 4710	27 ± 13
1996 to 2000	Regional Upgradient[1]	6.6 ± 3.4	11862 ± 3368	15374 ± 12632	21145 ± 8413	37 ± 30
	Effluent System[2]	16.2 ± 7.9	100120 ± 16698	220450 ± 34810	156095 ± 43451	58 ± 21
	Local Downgradient[3]	8.9 ± 7.2	17240 ± 2932	43545 ± 8258	42464 ± 7623	100 ± 65
	Regional Downgradient[4]	4.9 ± 4.1	13226 ± 2756	23884 ± 8909	27786 ± 5654	32 ± 15

(a) Secondary Maximum Contaminant Level (MCL) (This is not an enforceable value but rather a recommendation.)

NA=MCL not determined

Well Group Configuration

[1]Regional Upgradient Well Group:	USGS 12 and NRF-7
[2]Effluent System Well Group:	NRF-6
[3]Local Downgradient Well Group:	NRF-8 through NRF-12 and USGS 102
[4]Regional Downgradient Well Group:	USGS 97, USGS 98, and USGS 99

3.4.2.3 Drinking Water

INL

INL routinely monitors drinking water to ensure it is safe for consumption and to demonstrate that it meets federal and state regulations (ESER 2011). Drinking water parameters are regulated by the state of Idaho under authority of the SDWA. Parameters with primary MCLs must be monitored at least once every 3 years. Parameters with secondary MCLs are monitored every 3 years based on a recommendation by the EPA. Sampling is generally more frequent when establishing a baseline, and subsequent sampling parameters/frequency are determined from the baseline result. Currently the INL has 11 drinking water systems. Drinking water samples collected from these systems in 2009 and 2010 were well below drinking water limits for all regulatory parameters (ESER 2011).

NRF

NRF has five deep wells that provide water for all operations at NRF. The five wells are between 152 and 183 meters (500 and 600 feet) deep. Two wells (NRF-3 and NRF-14) are used for drinking water. One well (NRF-2) was used until 2006 for drinking water, but is currently out of service with the intention that it could be returned to service in the future if needed. The two remaining wells (NRF-1 and NRF-4) are used primarily for site operations, cooling, lawn watering, and the fire protection system.

Water for domestic use at NRF is currently processed through a water softener system which utilizes common salt (sodium chloride) to recharge the water softening resins. The use of softened water significantly reduces hard water deposits or scale build-up which extends equipment life, reduces maintenance costs, and minimizes the need to use other chemical treatments to contend with the consequences of using hard water.

To prevent the contamination of drinking water wells, IDEQ 1997 and IDEQ 1999 recommended the delineation of wellhead protection areas. These protection areas are defined as surface and subsurface areas surrounding a well through which contaminants could move and contaminate the well over specified time periods. The INL Source Water Assessment Program (DOE 2003a) delineates these areas for the NRF drinking water wells with the intent of minimizing impact to existing and future operations on drinking water supplies. Delineations were conducted using methods that meet the guidelines in the Idaho Wellhead Protection Plan (IDEQ 1997) and the Idaho Source Water Assessment Plan (IDEQ 1999). The protection zones indicate the areas within which management is advisable. The approach that is generally taken is to delineate the zones surrounding the wellhead, with the management level applied in each zone varying depending on the zone’s proximity to the well. The most restrictive protection measures are applied in the zone closest to the wellhead because a contaminant can travel from the release point through the aquifer to the well in a shorter time. Management and control measures are progressively less restrictive in more distant protection zones. Management and control measures taken at NRF to reduce the potential of contaminating drinking wells include: spill prevention and cleanup programs; a wastewater discharge management plan; waste management programs; and a drinking water monitoring program. These plans and programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections.

The 3-year capture zone for the two NRF drinking wells extends northward and encompasses the IWD and retired sewage lagoons. Constituents released from the IWD and retired sewage lagoons included calcium, chloride, potassium, sodium, and sulfate. The concentration of these non-hazardous water softening and demineralization process ions had no detrimental effect on the quality of the groundwater. The concentrations of aluminum and iron emanating from the IWD and retired sewage lagoons were elevated compared to background in some of the groundwater monitoring wells (Table 3.4-6). However, significant amounts of these metals have not been detected in drinking water. Groundwater at NRF also contains slightly elevated levels of ^{3}H when compared to background (Table 3.4-6). However, these levels are approximately 100 times less than the drinking water limit. The source of ^{3}H is downgradient of the capture zones for the drinking water wells and therefore does not impact the drinking water. The 6-year and 10-year capture zones for the NRF drinking water wells both underlie uninhabited areas of the INL, which do not contain any potential sources of groundwater contamination.

NRF drinking water is monitored regularly and meets all state of Idaho requirements for drinking water quality. A comprehensive drinking water monitoring program is in place that includes collection and analysis of drinking water samples in compliance with requirements established by the state of Idaho and the SDWA. Results of the monitoring program are reported, as required, to the state of Idaho per the requirements of applicable federal and state regulations.

NRF drinking water samples are collected from selected locations within the distribution system and sent to a State-certified laboratory to be analyzed for various non-radiological parameters. Samples are analyzed for VOCs, semivolatile organic compounds, inorganic compounds, coliform and E. coli bacteria, nitrate and nitrite. Analytical results show that no contaminants are present in NRF drinking water above established MCLs (BBI 2005, BBI 2006b, BBI 2007, BMPC 2008, BMPC 2009a).

In 2009, Wells NRF-3 and NRF-14 were sampled monthly (NRF-14 beginning in March) for ^{3}H, gross alpha, and gross beta. All samples were below the MDL for ^{3}H. Gross alpha and gross beta were detected in some samples, but were always below the MCL.

3.4.2.4 Water Use and Rights

INL

The SRPA is the only source of water for INL facilities. Since 1950, DOE has held a Federal Reserved Water Right for INL that permits a maximum water consumption of 43 billion liters (11.4 billion gallons) per year from the SRPA. Total groundwater withdrawal at INL historically averages between 15 and 20 percent of that permitted amount (DOE 2002d). For example, from 1982 to 1985, INL used about 7.9 billion liters (2.1 billion gallons) of water per year from the SRPA. This represents less than 0.3 percent of the total groundwater withdrawn from the aquifer by activities (e.g., crop irrigation and drinking water) in southeastern Idaho. In 2009, INL's production well system withdrew a total of about 3.6 billion liters (949 million gallons) of water, which is below the historical average (INL 2010e). The volume pumped in 2009 is approximately 8 percent of the Federal Reserved Water Right for INL. Some of the groundwater withdrawn for use by INL facilities is returned to the subsurface via percolation ponds and IWDs (DOE 2002d).

NRF

Average annual water use (potable and non-potable) at NRF based on 5 years of data (2005-2009) was approximately 140 million liters (37 million gallons), and ranged from 118 million liters (31 million gallons) to 156 million liters (41 million gallons). The average water use is about 0.3 percent of the Federal Reserved Water Right for INL.

3.5 Ecological Resources

This section describes the affected environment for ecological resources on INL, including environmentally sensitive areas; ecological resource management requirements and goals; plant communities; wildlife; threatened, endangered, and rare species; and wetlands. Wildfires and concerns associated with ecological resources are also addressed. The ROI for ecological impacts includes those areas at NRF which will potentially be disturbed by construction and operations activities, the surrounding INL land area, and vegetation and wildlife in Federal Class I areas that could be impacted by air pollutants. General characteristics of INL are described, followed by facility specific descriptions based on ecological surveys of NRF.

3.5.1 INL Environmental Conditions and Sensitive Areas

INL occupies 2300 square kilometers (900 square miles) of sagebrush steppe on the western edge of the ESRP in southeast Idaho. Meteorology and climatology of INL are described in Section 3.6.1. Harsh winter and summer conditions place severe constraints on plant growth and animal survival. In spite of harsh conditions, around 400 species of vascular plants and 200 animal species have been identified on INL.

INL was designated as a National Environmental Research Park in 1975 and is one of the few protected reserves of sagebrush steppe habitat. The land was set aside for ecosystem preservation, education, and study. About 40 percent of the area has been closed to cattle grazing for over 50 years. Approximately 94 percent of INL land is open and undeveloped. Protection from cattle grazing and development has contributed, in part, to a rich diversity of native plant species on INL. Native species make up approximately 85 percent of the total plant species supported on INL (Anderson et al. 1996). Numerous plant and animal studies have been conducted within the National Environmental Research Park.

In the 1950s, two permanent long-term vegetation transects were established at INL. The data sets associated with these transects are some of the oldest and most comprehensive of DOE's data sets describing sagebrush steppe ecology (ESER 2010). Studies based on data from these transects have contributed substantially to the understanding of vegetation dynamics in sagebrush steppe habitat. Data continue to be collected from these transects and protection of the transect area is considered important to future studies and understanding of sagebrush steppe ecosystems. NRF is several kilometers (several miles) from the nearest long-term vegetation transect.

In 1995, the National Biological Service listed the sagebrush steppe ecosystem as a critically endangered system across its entire range. The Sagebrush Steppe Ecosystem Reserve was established in 1999 on 29,650 hectares (73,260 acres) in the northwest corner of INL. The area was set aside for conservation management with the objectives of maintaining current plant communities and providing the opportunity for study of an undisturbed sagebrush steppe ecosystem. A Sagebrush Steppe Ecosystem Reserve Final Management Plan (DOE 2004a) was established that identified management goals to facilitate long-term health of this ecosystem. Since establishment of the Sagebrush Steppe Ecosystem Reserve, documentation and studies of plant communities and selected sensitive animal species have occurred. NRF is 10 kilometers (6 miles) from the Sagebrush Steppe Ecosystem Reserve.

3.5.2 INL Ecological Resource Management Objectives

INL ecological resource management is subject to EOs; federal, state, and DOE mandates for protecting biological resources (e.g., Endangered Species Act (ESA)); National Environmental Research Park objectives (DOE 2003b); and the Candidate Conservation Agreement (CCA) for greater sage-grouse (*Centrocercus urophasianus*) (DOE and USFWS 2014). DOE and the USFWS cooperatively developed a CCA for the INL that provides for the protection of greater sage-grouse and its habitat while allowing DOE to fulfill its present and future missions. The CCA was finalized in October 2014. In addition, DOE and NNPP are in the process of developing a bat protection plan for the INL that will provide for the protection of bat populations and their habitat (DOE 2016).

INL land stewardship is defined in terms of ecosystem management and sustainable development, with the goals of restoring and sustaining health, productivity, and biological diversity of ecosystems in a way that is fully integrated with social and economic goals. The goal of ecological resource management on INL is to perpetuate and protect a large area of unfragmented native sagebrush steppe ecosystem, and comply with existing policy and mandates, while supporting DOE's critical missions (DOE 2003b). Certain measures have been identified that can be implemented to reduce or eliminate impacts to ecological resources from needed construction and improvement activities on INL. Examples of ecological resource management objectives, which specifically apply to the proposed action, include:

- Protect threatened, endangered, and sensitive species (this includes state of Idaho designated species) and their habitat. The ESA requires that federal agencies "shall seek to conserve endangered and threatened species." The goal of this objective is to ensure that ESA-listed and Idaho-designated species are not adversely impacted by the proposed action.

- Protect greater sage-grouse and other sagebrush-obligate species and their habitat. Sagebrush-obligate species depend on sagebrush for most of their living requirements (e.g., food, shelter, reproduction). Because certain sagebrush-obligate species have declining populations throughout their ranges and risk being listed under ESA, the goal of this objective is to protect INL populations of greater sage-grouse and other sagebrush-obligate species and their habitat.

- Prevent habitat loss and fragmentation. Habitat loss and fragmentation can adversely impact plant and animal species, biodiversity, and ecosystem stability. The goal of this objective is to minimize or prevent habitat loss and fragmentation.

- Maintain a large undeveloped, sagebrush steppe ecosystem. The goal of this objective is to conserve large tracts of sagebrush to eliminate impacts to flora, fauna, biodiversity, and threatened and endangered species depending on this ecosystem.

- Protect unique ecological research opportunities. The goal of this objective is to preserve research opportunities unique to the sagebrush steppe ecosystem on INL.

- Prevent invasion of non-native species, including noxious weeds. Ground-disturbing activities, particularly in close proximity to or adjacent to seed sources, exacerbate the invasion of noxious species. The goal of this objective is to prevent or minimize invasion of non-native and noxious biota due to the proposed action.

3.5.3 Vegetation

3.5.3.1 Plant Communities

INL

General INL plant community descriptions based on Anderson et al. 1996 and Shive et al. 2011 are provided below. The community descriptions specific to NRF are based on field surveys (Hafla et al 2012) and vegetation classes in Shive et al. 2011.

Sagebrush steppe is the most common plant community at INL, with the Big Sagebrush (*Artemisia tridentata*) Shrubland vegetation class the largest and most inclusive. Basin Big Sagebrush (*Artemisia tridentata* ssp. *tridentata*) and Wyoming Big Sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) Shrubland classes are also relatively common. Basin big sagebrush tends to dominate on deep, well drained, sandy soils, such as soils found on the lee side of lava ridges, where sand accumulates. Conversely, Wyoming big sagebrush tends to dominate on fine-textured shallow soils. Native perennial grasses are typically more abundant in the understory (an underlying layer of vegetation) of communities dominated by Wyoming big sagebrush than they are in the understory of communities dominated by basin big sagebrush. Cheatgrass (*Bromus tectorum*) may be common in the understory of basin big sagebrush stands, but tends to be rare in the understory of Wyoming big sagebrush stands. Aside from differences in grass abundance, communities dominated by either subspecies of sagebrush can have similar composition of understory species. Other common shrub species in these communities include green rabbitbrush (*Chrysothamnus viscidiflorus*), gray rabbitbrush (*Ericameria nauseosa*), winterfat *(Krascheninnikovia lanata*), spiny hopsage (*Grayia spinosa*), prickly phlox (*Leptodactylon punfens*), and broom snakeweed (*Gutierrezia sarothrae*).

Other sagebrush steppe communities that are recognized on INL may be dominated by one of the low sagebrushes such as black sagebrush (*Artemisia nova*) or little sagebrush (*Artemisia arbuscula*). These species typically occur on shallow soils, with little sagebrush usually found on foothill slopes.

Green rabbitbrush is dominant in some plant communities (e.g., Green Rabbitbrush Shrubland class and associated complexes), or it may be co-dominant with Wyoming big sagebrush or winterfat (e.g., Big Sagebrush Shrubland class and Green Rabbitbrush-Winterfat Shrubland class). These communities often have a high diversity of perennial grasses and forbs. Common perennial grasses in these communities include thickspike wheatgrass (*Elymus lanceolatus*), bottlebrush squirreltail (*E. elymoides*), Indian ricegrass *(Achnatherum hymenoides*), needle-and-thread grass (*Stipa comata*), and Great Basin wildrye (*Leymus cinereus).* Cheatgrass can be abundant in these communities, where they occur on course textured soils. Common forbs include Hood's phlox *(Phlox hoodii*), ballhead ipomopsis (*Ipomopsis congesta*), Wilcox's woollystar (*Eriastrum wilcoxii*), hoary aster (*Machaeranthera canescens*), and Douglas' dustymaiden (*Chaenactis douglasii*).

Two classes of vegetation identified on INL are dominated by shrubs in the chenopod family. The first is dominated by shadscale (Shadscale Dwarf Shrubland class) with occurrence of winterfat and greasewood (*Sarcobatus vermiculatus*). Spiny hopsage (*Grayia spinosa*) and sparse cover of grasses may also be present. The second type is dominated by spiny hopsage (Spiny Hopsage Shrubland class), with sporadic occurrence of sagebrush and/or green rabbitbrush. These vegetation classes tend to occur on playas formed within the Lake Terreton basin, the Big Lost River, and Birch Creek.

Several grassland classifications have been identified on INL. These grasslands support a rich variety of perennial grasses. Low lying areas where deep soils accumulate support nearly pure stands of Great Basin wildrye. Other grasslands are dominated by rhizomatous species such as thickspike wheatgrass, western wheatgrass (*Pascopyrum smithii*), creeping wildrye (*Leymus triticoides*), or Douglas' sedge (*Carex douglasii*). In others, the dominant species are bunchgrasses, such as Indian ricegrass, bottlebrush squirreltail, needle-and-thread grass, Sandberg bluegrass (*Poa secunda*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). Grasslands may also be interspersed with shrubs, which include black sagebrush, big sagebrush, green rabbitbrush, and prickly phlox. Prickly-pear cactus (*Opuntia polyacantha*) can be abundant in mixed grassland communities. A number of native forbs are also common including Hood's phlox, globe-mallow (*Sphaeralcea munroana*), Douglas' dustymaiden, small-flowered mentzelia (*Mentzelia abicaulis*), western tansy-mustard (*Descurainia pinnata*), and western stickseed (*Lappula occidentalis*). Invasive, non-native species can be abundant in grasslands. These include tall tumblemustard (*Sisymbrium altissimum*), desert alyssum (*Alyssum desertorum*), salsify (*Tragopogon dubius*), and cheatgrass. The grassland classifications also include areas that were seeded with, or invaded by, the introduced crested wheatgrasses (*Agropyron desertorum* or *A. cristatum*) following disturbances (e.g., Crested Wheatgrass Semi-natural Herbaceous Vegetation class).

The presence of Utah juniper *(Juniperus osteosperma*) is characteristic of the Utah Juniper Woodland classification, which generally occurs on buttes, alluvial fans, and foothills. In these communities, Utah juniper is either dominant or co-dominant with Wyoming big sagebrush or black sagebrush. Other common shrubs include threetip sagebrush (*Artemisia tripartita*), green rabbitbrush, and shrubby buckwheat. Perennial grasses include Indian ricegrass, needle-and-thread grass, and bluebunch wheatgrass. Common forbs are arrowleaf balsamroot (*Balsamorhiza sagitata*), tapertip hawksbeard (*Crepis acuminata*), Hood's phlox, Douglas' dustymaiden, and ballhead ipomopsis.

Wetland vegetation is present in the USACOE jurisdictional wetlands at the Big Lost River sinks. These areas are periodically flooded during years of high precipitation (Section 3.4.1.1). Part of this area was a cattail (*Typha latifolia*) marsh in the early to mid 1980's. The dominant species over much of the area is common spike-rush (*Eleocharis palustris*). Western wheatgrass becomes more common towards the margins as the wetlands grade into grasslands. Species diversity of these wetlands are very low. See Section 3.4.1.1 for location of wetlands and distance of wetlands from NRF.

In areas where past disturbance or periodic flooding have resulted in a high proportion of exposed soil, non-native annuals establish and often dominate. These non-native plants include summer cypress (*Kochia scoparia*), poverty weed (*Iva axillaris*), Russian thistle (*Salsola kali*), and verbena (*Verbena bracteata)*. These communities also occur in borrow sources and gravel covered areas associated with roads and facilities.

Plants are sparse in areas on INL with exposed lava flows. Common species on lava flows include basin big sagebrush, gray rabbitbrush, and fernbrush (*Chamaebatiaria millefolia*). The relatively recent lava flow south of INL Main Gate and on the slopes of Middle Butte are the most extensive on INL.

NRF

Vegetation surveys were conducted at NRF in June 2011 and June 2012 (Hafla et al. 2012). Five vegetation communities were sampled outside of the fenced area (Figure 3.5-1). Sampled areas are outlined in Figure 3.5-1 and are described below. A list of plant species with measured ground cover for each of the sampled communities can be found in Hafla et al. 2012. Additional vegetation communities shown in Figure 3.5-1 that were not sampled during the vegetation surveys were delineated from INL vegetation map (Shive et al. 2011). Locations where wildlife signs were found are discussed in Section 3.5.4.1.

In disturbed areas closer to the facility perimeter and roads, semi-natural communities (invaded or dominated by non-native species) have established:

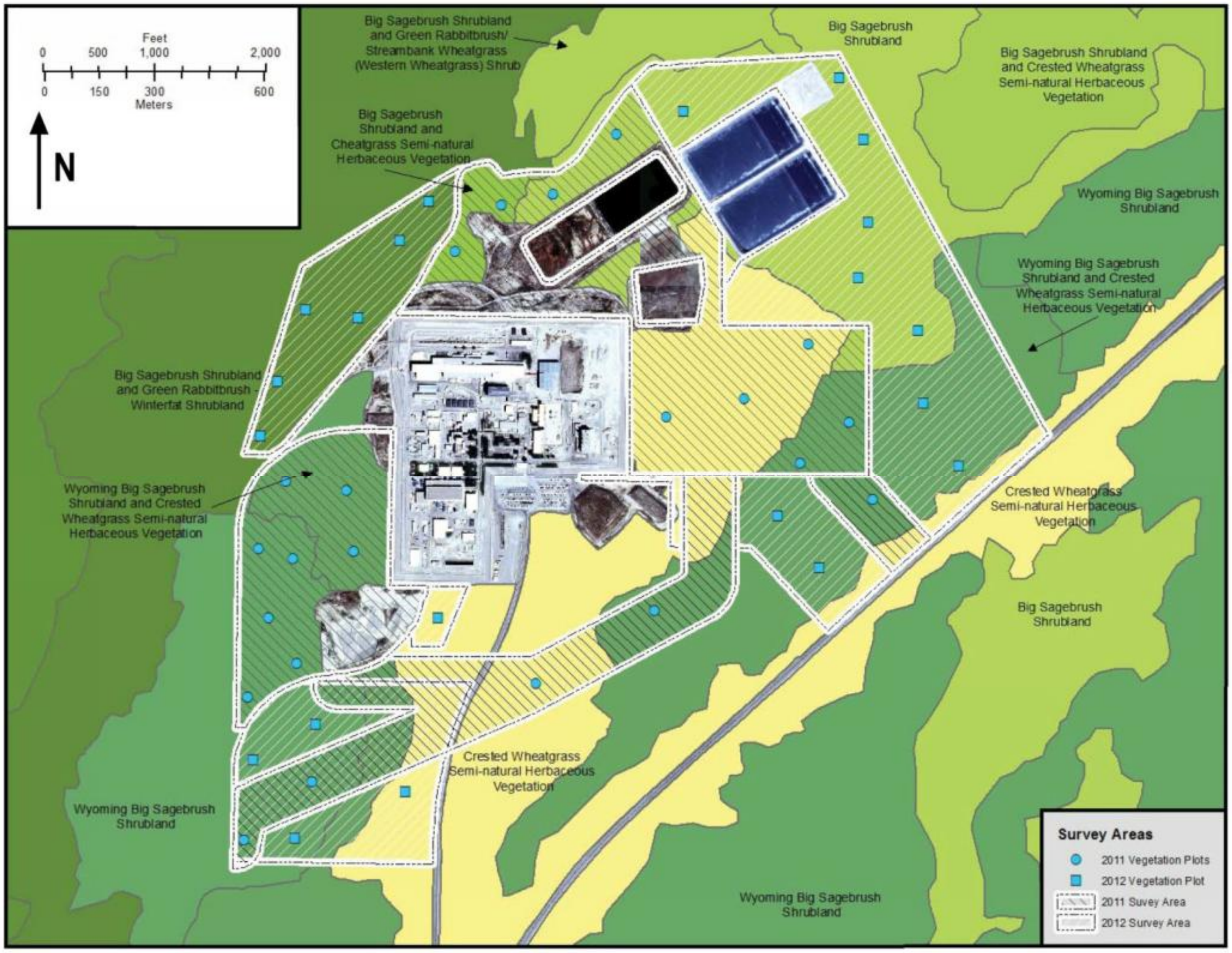
- Crested Wheatgrass Semi-natural Herbaceous Vegetation class
- A complex of Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation classes
- Big Sagebrush (*Artemisia tridentata*) and Cheatgrass (*Bromus tectorum*) Semi-natural Herbaceous Vegetation class

Undisturbed native vegetation communities are present in areas that are further from facilities and roads:

- Wyoming Big Sagebrush Shrubland class
- Big Sagebrush Shrubland class

Crested Wheatgrass Semi-natural Herbaceous Vegetation class is the dominant vegetation community near the NRF facility to the south and east (Figure 3.5-1). This community was repeatedly disturbed by NRF activities, seeded with aggressive non-native species (e.g., crested wheatgrass) (past practice), and allowed to be colonized with other non-native species (e.g., cheatgrass, halogeton (*Halogeton glomeratus*), and tall tumblemustard). These areas have likely passed the threshold of being able to be reclaimed back to native vegetation, but still support wildlife. Vegetation cover in this community consists of about half native species and half non-native species (Hafla et al. 2012). The native perennial vegetation is dominated by Wyoming big sagebrush, with co-occurring big sagebrush and green rabbitbrush. Total cover of native perennial grasses and forbs was low in 2011 and 2012. The non-native vegetation is dominated by crested wheatgrass with some cheatgrass and desert alyssum.

A complex of Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation classes occurs adjacent to the facility on the west and adjacent to the crested wheatgrass community to the south and east (Figure 3.5-1). This community has also been disturbed by NRF activities and seeded in some areas with crested wheatgrass (past practice). This community has a greater proportion of native species than non-native species compared to the Crested Wheatgrass Semi-natural Herbaceous Vegetation class. The native perennial vegetation in this area is dominated by Wyoming big sagebrush, with big sagebrush and green rabbitbrush co-occurring. Native grasses are also present. Native grasses in this community include Sandberg bluegrass, thickspike wheatgrass, and western wheatgrass. Several native perennial and annual forb species were identified but absolute mean forb cover was low. Non-native species included crested wheatgrass, cheatgrass, and desert alyssum.



Source: Hafla et al. 2012

Figure 3.5-1: Ecological Survey Area and Vegetation Communities at NRF

The Wyoming Big Sagebrush Shrubland class to the southwest of NRF that was sampled (Figure 3.5-1) is dominated by native species with few non-native species. Green rabbitbrush and Wyoming big sagebrush are co-dominant. Native grasses include Indian ricegrass, thickspike wheatgrass, and western wheatgrass. Several native perennial and annual/biennial forb species were identified. Non-native species were primarily crested wheatgrass with some cheatgrass, desert alyssum, and herb sophia (*Descurainia sophia*).

The Big Sagebrush Shrubland class on the north side of NRF is dominated by native species with big sagebrush, green rabbitbrush, and spiny hopsage. Native grasses include bottlebrush squirreltail (*Elymus elymoides*), western wheatgrass, and Sandburg bluegrass. Native forbs include shaggy fleabane (*Erigeron pumilus*) and Hood's phlox. Non-native species include crested wheatgrass, cheatgrass, and desert alyssum.

The Big Sagebrush and Cheatgrass Semi-natural Herbaceous Vegetation community on the northwest side of NRF that was sampled is dominated by native species with an understory of cheatgrass. Big sagebrush is the dominant shrub. Wyoming big sagebrush and shrubs with lesser cover are also present. Native grasses include bottlebrush squirreltail, western wheatgrass, and

Sandburg bluegrass. Native forb cover was low. Non-native species include crested wheatgrass, cheatgrass, and tall tumblemustard.

3.5.3.2 Invasive and Non-Native Plant Species

Idaho noxious weeds are those species that have been designated as noxious by law in IDAPA 02, Title 06, Chapter 22. These species are known to make significant modifications to the landscape if left unchecked; therefore, administrative rules for managing them have been established in IDAPA 02, Title 06, Chapter 22.

INL

INL has implemented noxious weed management plans to meet the IDAPA requirements. Based on delineated ranges for Idaho noxious weed species in the U.S. Department of Agriculture Natural Resources Conservation Service Plants Database (USDA 2013), it was determined that 19 species have the potential to occur on INL (Table 3.5-1). Vegetation surveys of INL have identified 17 noxious weed species (Table 3.5-1), with musk thistle (*Carduus nutans*) and Canada thistle (*Cirsium arvense*) most common.

Other invasive non-native plant species on INL that pose land management and conservation challenges include cheatgrass, crested wheatgrass, Russian thistle, halogeton, and tall tumblemustard. These species are characterized by the ability to quickly establish in disturbed areas, successfully compete with native species, and tenaciously persist once established.

NRF

NRF has also implemented a noxious weed management plan. Under this plan, surveys are performed of the NRF property in May, June, and July to locate noxious weeds, and records are kept of location and extent of populations. The surveys include all areas on the NRF property that are developed, used, disturbed, or irrigated. Control methods are implemented based on plant life cycle stage and repeated as needed to eradicate or keep populations from spreading. Noxious weeds identified at NRF during surveys are provided in Table 3.5-1.

Non-native plant species found during surveys conducted in 2011 and 2012 at NRF include cheatgrass, crested wheatgrass, desert alyssum, herb sophia, and tall tumblemustard (Hafla et al. 2012). Areas with summer cyprus, Russian thistle, and halogeton are also found at NRF.

Table 3.5-1: Noxious Weeds[1] on INL

Potential to Occur on INL		Identified During Surveys	
Scientific Name	**Common Name**	**INL**	**NRF**
Acroptilon repens	russian knapweed	x	
Cardaria draba	whitetop	x	
Carduus nutans	musk thistle	x	x
Centaurea diffusa	diffuse knapweed	x	
Centaurea solstitialis	yellow starthistle	x	
Centaurea stoebe ssp. *micranthos*	spotted knapweed	x	x
Cirsium arvense	Canada thistle	x	x
Chondrilla juncea	rush skeletonweed	x	x
Convolvulus arvensis	field bindweed	x	x
Conium maculatum	poison hemlock	x	
Euphorbia esula	leafy spurge	x	
Hyoscyamus niger	black henbane	x	
Linaria vulgaris	yellow toadflax	x	
Onopordum acanthium	scotch thistle	x	
Solanum elaeagnifolium	silverleaf nightshade		
Solanum rostratum	buffalobur	x	
Sonchus arvensis	perennial sowthistle	x	
Tribulus terrestris	puncturevine	x	

[1] Noxious weed list for Idaho taken from IDAPA 02, Title 06, Chapter 22.

3.5.3.3 Threatened, Endangered, and Sensitive Plant Species

The USFWS categories established under the ESA for describing the status of plants and wildlife are defined as follows:

- Endangered (E) – Species in danger of extinction throughout all or a significant portion of its range.
- Threatened (T) – Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
- Experimental Population, Non-essential (XN) – a population (including its offspring) of a listed species designated by rule published in the Federal Register that is wholly separate geographically from other populations of the same species. An experimental population may be subject to less stringent prohibitions than are applied to the remainder of the species to which it belongs. An experimental "non-essential" population is a population whose loss would not appreciably reduce the prospect of survival of the species in the wild.
- Proposed Endangered (PE) – Species that is proposed in the Federal Register to be listed as endangered under Section 4 of the ESA.
- Proposed Threatened (PT) – Species that is proposed in the Federal Register to be listed as threatened under Section 4 of the ESA.
- Candidate Taxon (C), Ready for Proposal – Species for which the USFWS or National Oceanic and Atmospheric Administration (NOAA) Fisheries has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened.

A list of threatened, endangered, proposed, and candidate plant species for Idaho counties was obtained from the USFWS-Idaho Fish and Wildlife Office (IFWO) web page (USFWS 2016). The list was evaluated for plant species that are known to occur in Butte, Bingham, Bonneville, Custer, and

Jefferson counties. These counties surround INL and were selected to narrow the county list to those that might have similar habitat to INL, not because they are in the ROI for ecological resources. Ute ladies' tresses (*Spiranthes diluvialis*) was identified as occurring in three of the five counties. This orchid grows only in moist soils associated with wetlands or floodplains of perennial streams in intermountain valleys, or in wet open meadows. This species requires soils that are moist to the surface throughout the growing season (USDA 2013). There is no habitat within INL boundaries that would support this species. No threatened, endangered, proposed, or candidate plant species are known to occur, or are expected to occur on INL.

Plant species listed by the state of Idaho as threatened or endangered, and those listed as species of greatest conservation need by the Idaho Conservation Data Center (ICDC) were also evaluated to determine the potential for occurrence in areas that could be disturbed by the proposed action. State categories for endangered or threatened species are defined the same as the federal categories. Statewide ranks (S Rank assigned by ICDC) and rangewide ranks (G Rank assigned by NatureServe) describing the status of plants and wildlife are defined as follows:

- Presumed extinct or extirpated (SX/GX) – Not located despite extensive searches and virtually no likelihood of rediscovery.
- Possibly extinct or extirpated (historical) (SH/GH) – Historically occurred, but may be rediscovered. Its presence may not have been verified in the past 20-40 years. The SH rank is reserved for species for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
- Critically imperiled (S1/G1) – at high risk because of extreme rarity (often five or fewer occurrences), rapidly declining numbers, or other factors that make it particularly vulnerable to rangewide extinction or extirpation.
- Imperiled (S2/G2) – At risk because of restricted range, few populations (often 20 or fewer), rapidly declining numbers, or other factors that make it vulnerable to rangewide extinction or extirpation.
- Vulnerable (S3/G3) – At moderate risk because of restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors that make it vulnerable to rangewide extinction or extirpation.
- Apparently secure (S4/G4) – Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- Secure (S5/G5) – Common, widespread, and abundant.
- Breeding (B) – Conservation status refers to the breeding population of the species.

State-listed plants and plant species of greatest conservation need were obtained from IDFG 2016 for Butte, Bingham, Bonneville, Custer, and Jefferson counties. No state-listed plant species were identified in these five counties. Plant species listed by the ICDC, Idaho Native Plant Society (INPS), U.S. Forest Service (USFS), and BLM that are known to occur on or near the boundary of INL are shown in Table 3.5-2. Those previously documented on INL were selected as target species for rare plant surveys conducted at NRF in June 2011 and June 2012 and include: Lemhi milkvetch (*Astragalus aquilonius*), wingfruit suncup (*Camissonia ptersoperma*), many branched ipomopsis (*Ipomopsis polycladon*), and perplexed halimolobos (*Halimolobos perplexa* var. *perplexa*). Habitat for these target species generally consists of gravelly slopes associated with sagebrush steppe and juniper communities. The topography at NRF is generally flat and the soils are primarily wind blown loess deposits. Such conditions would not likely support these rare plant species, and none were found during the surveys (Hafla et al. 2012).

Table 3.5-2: Status of Rare Vascular Plant Species and Occurrence on INL

Scientific Name	Common Name	Status	Organization	Comments
Documented on INL				
Astragalus aquilonius	Lemhi milkvetch	G3/S3 (Rare or uncommon but not imperiled)	ICDC	Documented in western foothills, Idaho endemic
		GP3 (Global Priority 3)	INPS	
		S (Taxa for which viability is a concern)	USFS	
		Type 4 (Species of concern - rare in Idaho with small populations and localized distributions)	BLM	
Camissonia pterosperma	wingfruit suncup	G4/S2 (Globally the species is apparently secure but it is imperiled at the state level)	ICDC	Documented in northwest foothills - juniper communities
		S (Taxa with small populations or localized distributions)	INPS	
		Type 4 (Species of concern - rare in Idaho with small populations and localized distributions)	BLM	
Halimolobos perplexa var. perplexa	perplexed halimolobos	G4T3/S3 (This variety is rare or uncommon, the species is apparently secure but with cause for long-term concern)	ICDC	Documented in buttes, Idaho endemic
		M (Common within a limited range)	INPS	
		S (Taxa for which viability is a concern)	USFS	
		Type 4 (Species of concern - rare in Idaho with small populations and localized distributions)	BLM	
Ipomopsis polycladon	manybranched ipomopsis	G4/S2 (Globally the species is apparently secure but it is imperiled at the state level)	ICDC	Documented in western foothills - juniper communities
		2 (State priority - likely to continue declining as long as habitat loss or degradation continues)	INPS	
		Type 3 (Rangewide/Globally Imperiled Species - Moderate Endangerment)	BLM	

Table 3.5-2: Status of Rare Vascular Plant Species and Occurrence on INL (cont.)

Scientific Name	Common Name	Status	Organization	Comments
Documented Near INL Boundary				
Astragalus gilviflorus	plains milkvetch	G5/S2 (Globally widespread and secure/State imperiled)	ICDC	Documented at Reno Point
		S (Taxa with small populations or localized distributions)	INPS	
		Type 3 (Rangewide/Globally Imperiled Species - Moderate Endangerment)	BLM	
Phacelia inconspicua	hidden phacelia	G2/S1 (Globally Imperiled/State critically imperiled - rare and vulnerable to extinction)	ICDC	Documented on Big Southern Butte
		GP1 (Globally rare and in danger of becoming extinct or extirpated from Idaho in the foreseeable future)	INPS	
		Type 2 (Rangewide/Globally Imperiled Species - High Endangerment)	BLM	
Source: Hafla et al. 2012, BLM 2016				

3.5.3.4 Ethnobotany

Anderson et al. 1996 compiled a list of species of potential cultural importance to indigenous groups (e.g., the Shoshone-Bannock Tribes) of the ESRP. This list was used to determine whether species of ethnobotanical importance were identified during the vegetation surveys at NRF (see Hafla et al. 2012 for survey methods and results). During the vegetation surveys, 23 species that have documentation concerning a plant's use were identified at NRF (Table 3.5-3); 12 of those species have documented use among indigenous groups of the ESRP. Certain shrubs (e.g., big sagebrush and rabbitbrush) and grasses (e.g., Indian ricegrass, bottlebrush squirreltail, and wheatgrasses) with documented use are common in plant communities at NRF and are well represented on INL. Some of the forbs are less common at NRF, occurring on only one or two sample plots (e.g., textile onion (*Allium textile*), tapertip hawksbeard (*Crepis acuminate*), and western tansymustard) (Hafla et al. 2012).

Table 3.5-3: Plant Species of Ethnobotanical Importance Identified at NRF

Scientific Name	Common Name	DU[1]	Uses
Shrubs			
Artemisia tridentata	big sagebrush	+	leaf used for medicine, clothing and dye; bark used for cordage and clothing; plant used for shelter; trunk used for fuel; and seed used for food
Atriplex falcata	sickle saltbush	?	seed used for food
Chrysothamnus viscidiflorus and *Ericameria nauseosa*	rabbitbrush	+	plant and root used for medicine; bark of lower stem and root used for gum
Grayia spinosa	spiny hopsage	?	seed used for food
Graminoids			
Achnatherum hymenoides	Indian ricegrass	+	seed used for food
Carex douglasii	Douglas' sedge	+	shoot, bulb, and seed used for food
Elymus elymoides	bottlebrush squirreltail	-	seed used for food
Elymus spp *Pascopyrum smithii*	wheatgrasses	-	seed used for food; root used for medicine
Hesperostipa comata	needle-and- thread grass	-	seed used for food
Poa secunda	Sandberg bluegrass	+	seed used for food; spikelet used for medicine
Forbs			
Allium textile	textile onion	+	leaf and bulb used for food; boiled juice of bulb used for medicine and flavoring; bulb skin used for dye
Arabis holboellii	rock cress	-	seed used for food
Chaenactis douglasii	Douglas' dustymaiden	?	leaf and root used for medicine
Chenopodium fremontii	Fremont's goosefoot	+	seed and young plant used for food
Chenopodium leptophyllum	slimleaf goosefoot	+	seed and young plant used for food
Crepis acuminata	tapertip hawksbeard	-	leaf used for food
Delphinium andersonii	larkspur	+	seed and flower used for medicine; flower used for dye
Descurainia pinnata	western tansymustard	+	seed is used for food and medicine
Erigeron pumilus	shaggy fleabane	-	root, leaf, flower used for medicine; root used for arrow tip poison
Eriogonum ovalifolium	cushion buckwheat	?	flower used for medicine
Lappula occidentalis	stickseed	+	seed and root used for food
Opuntia polycantha	plains prickly pear	+	stem and fruit used for food
Sisymbrium altissimum	tall tumblemustard	-	seed and leaf used for food

Source: Anderson et al. 1996
[1] DU = documented use; Symbols: + = documented use among indigenous groups of the ESRP, ? = use inferred from documented use among neighboring groups, - = potential for use, but no documentation found

3.5.4 Wildlife

INL

INL supports wildlife typical of sagebrush steppe vegetation communities. Five fish, one amphibian, nine reptile, 159 bird, and 37 mammal species have been observed on the site (Stoller 2011). Fifty-six vertebrate species are year-long residents of INL and include reptiles (e.g., short-horned lizard (*Phrynosoma douglassi*) and gopher snake (*Pituophis melanoleucus*)), birds (e.g., common raven (*Corvus corax*)), and small to medium sized mammals (e.g., Great Basin ground squirrel (*Spermophilus mollis*), least chipmunk (*Tamias minimus*), mountain cottontail rabbit (*Sylvilagus* nattallii), badger (*Taxidea* taxus), black-tailed jackrabbit (*Lepus californicus*), and coyote (*Canis latrans*)). There are 154 vertebrate species present during specific seasons or during migration; these include pronghorn (*Antilocapra americana*), elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and a wide variety of migratory bird species.

NRF

Landscaped areas (lawns and trees), buildings, and staging areas inside the perimeter fence of NRF provide areas for wildlife use. Several small mammal species, such as least chipmunk, bushy-tailed woodrat (*Neotoma cinerea*), deer mouse (*Peromyscus maniculatus*), meadow vole (*Microtus Pennsylvanicus*) and mountain cottontail rabbit, are commonly found in the developed area inside the fence. These small mammals are also found in the undeveloped areas outside of the perimeter fence. Badger and coyote are commonly found outside of the NRF perimeter fence. The Great Basin ground squirrel is common along the IWD. The meadow vole is common in vegetated CERCLA covers. Sagebrush lizards (*Sceloporus graciosus*), short-horned lizards, and gopher snakes are commonly seen outside the perimeter fence. Elk, pronghorn, and mule deer sign have been observed outside of the perimeter fence indicating transient use of undeveloped areas.

3.5.4.1 Threatened, Endangered, and Sensitive Animal Species

A list of threatened, endangered, candidate, and proposed animal species for Idaho counties was obtained from the USFWS-IFWO web page (IFWO 2016). The list was evaluated for animal species that are known to occur in Butte, Bingham, Bonneville, Custer, and Jefferson counties. The status of the western yellow-billed cuckoo (*Coccyzus americanus*) was determined from 50 C.F.R. § 17. Three threatened and one candidate animal species were identified in the surrounding counties (Table 3.5-4). The Canada lynx (*Lynx canadensis*), grizzly bear (*Ursus arctos horribilis*), and western yellow-billed cuckoo are listed as threatened species and were identified as occurring in one or more of the counties evaluated. The Canada lynx is typically found in forested habitats, while the grizzly bear is typically found in a variety of habitats within the Greater Yellowstone area. The western yellow-billed cuckoo is found in riparian habitats. There is no suitable habitat on INL for these three species. No critical habitat for threatened or endangered species, as defined in the ESA, exists on INL.

The gray wolf (*Canus lupus*) (northern Rocky Mountain population) was removed from the endangered species list in the spring of 2011. The wolf is currently managed in Idaho as a big game animal. The gray wolf is seen occasionally on INL (DOE 2005a). However, it is typically found in forest and tundra habitat, and its occasional presence on INL is transitory.

Although the greater sage-grouse was listed as a candidate species, the USFWS determined that listing the bird as threatened or endangered was not warranted and removed it from the candidate species list in the fall of 2015. However, the INL (including NRF) will be subject to the CCA for the greater sage-grouse for a period of 20 years or until one of the parties elects to withdraw (DOE and

USFWS 2014). The greater sage-grouse is known to occur on INL and is discussed in more detail below.

Wildlife listed as “species of greatest conservation need” by the state of Idaho were also evaluated to determine the potential for occurrence on INL. The list of Idaho Species of Greatest Conservation Need was obtained from the Idaho Department of Fish and Game website (IDFG 2016). Those state-listed species known to occur in Butte, Bingham, Bonneville, Custer, and Jefferson counties were evaluated for habitat requirements and considered in the facility specific surveys, where appropriate (Table 3.5-4). Those known to occur on INL that are sagebrush-obligate species were considered in site-specific surveys.

The bald eagle is no longer a federally-listed species but is still protected by the Bald and Golden Eagle Protection Act. The bald eagle has rarely been observed on INL. It forages near rivers, lakes, or other water bodies. The bald eagle typically nests in trees along rivers and winters near open water. Bald eagles do not nest on INL (Shurtliff 2010), and winter habitat does not occur in the vicinity.

Table 3.5-4: Status of Threatened, Endangered, and Special Status Animal Species and Potential for Occurrence on INL

Scientific Name	Common Name	Status		Comments
		Federal[1]	State[2]	
Aquila chrysaetos	golden eagle	Bald and Golden Eagle Protection Act USFWS bird of concern	Idaho Protected Nongame	Known to occur (rarely) on INL in remote areas away from facilities. Not sited in vicinity of NRF.
Amphispiza belli	sage sparrow	USFWS bird of concern BLM[2] Type 2	Idaho Protected Nongame	Known to occur on INL. Common in sagebrush outside NRF perimeter fence. Sagebrush-obligate species.
Brachylagus idahoensis	pygmy rabbit	BLM Type 2	S2	Known to occur on INL. Sagebrush-obligate species.
Centrocercus urophasianus	greater sage-grouse	USFWS bird of concern BLM Type 2	S2	Known to occur on INL. Sagebrush-obligate species. Sage-grouse sign documented at NRF.
Coccyzus americanus	western yellow-billed cuckoo	ESA Threatened USFWS bird of concern BLM Type 1	S2B	Known to occur in four of the counties of concern. Typically associated with riparian habitat. No suitable habitat on INL.

Sources: IDFG 2016, BLM 2016; USFWS 2016; 50 C.F.R. § 17, including changes dated October 2, 2015; and IDAPA 13.01.06
NA = Not applicable
Note: Only bats affected by white nose syndrome are listed here.
[1] See Table 3.5-2 for BLM category definitions.
[2] See Section 3.5.3.3 for S category definitions.

Table 3.5-4: Status of Threatened, Endangered, and Special Status Animal Species and Potential for Occurrence on INL (cont.)

Scientific Name	Common Name	Status		Comments
		Federal[1]	State[2]	
Eptesicus fuscus	big brown bat	BLM Type 2	Idaho Protected Nongame S4	Known to occur on INL in buildings, caves, and lava tubes year around. Affected by white nose syndrome. Occurs at NRF.
Lynx canadensis	Canada lynx	ESA Threatened BLM Type 1	Threatened S1	Identified in four of the counties of concern. Typically associated with forested habitats and may use riparian habitat along rivers as travel corridors. No suitable habitat on INL.
Myotis ciliolabrum	western small-footed myotis	BLM Type 2	Idaho Protected Nongame S4	Known to occur on INL in buildings, caves, and lava tubes year around. Affected by white nose syndrome. Occurs at NRF.
Myotis evotis	western long-eared myotis	BLM Type 5	Idaho Protected Nongame S3	Southeast and northwest INL in caves and junipers during summer and autumn. Affected by white nose syndrome. Occurs at NRF.
Myotis lucifugus	little brown myotis	Petitioned for emergency ESA listing BLM Type 2	Idaho Protected Nongame S5	Known to occur on INL. Roosts in buildings during the summer and autumn. Affected by white nose syndrome. Occurs at NRF.
Numernius americanus	long-billed curlew	USFWS bird of concern BLM Type 2	Idaho Protected Nongame S2B	Known to occur (rarely) on INL. Sighted rarely at the NRF sewage lagoons.
Falco peregrinus	peregrine falcon	USFWS bird of concern BLM Type 3	Idaho Protected Nongame S2B	Seen occasionally on INL. Thrive near coasts where shorebirds are common but can be found everywhere from tundra to deserts.
Haliaeetus leucocephalus	bald eagle	Bald and Golden Eagle Protection Act USFWS bird of concern	Idaho Protected Nongame S3B, S4N	Seen occasionally on INL. Typically found in riparian areas; winters near open water. No suitable habitat on INL.

Sources: IDFG 2016; BLM 2016; USFWS 2016; 50 C.F.R. § 17, including changes dated October 2, 2015; and IDAPA 13.01.06
NA = Not applicable
Note: Only bats affected by white nose syndrome are listed here.
[1] See Table 3.5-2 for BLM category definitions.
[2] See Section 3.5.3.3 for S category definitions.

Table 3.5-4: Status of Threatened, Endangered, and Special Status Animal Species and Potential for Occurrence on INL (cont.)

Scientific Name	Common Name	Status		Comments
		Federal[1]	State[2]	
Lanius ludovicianus	loggerhead shrike	USFWS bird of concern BLM Type 3	Idaho Protected Nongame	Known to occur (rarely) on INL. Sighted rarely on fence poles and other perches near NRF.
Oreoscoptes montanus	sage thrasher	USFWS bird of concern BLM Type 5	Idaho Protected Nongame	Known to occur on INL. Sagebrush obligate species.
Phalaropus tricolor	Wilson's phalarope	BLM Type 5	Idaho Protected Nongame S3B	Known to occur on INL. Sighted regularly at the NRF sewage lagoons.
Ursus arctos horribilis	grizzly bear	ESA Threatened BLM Type 1	Threatened S1	Identified in Bonneville County. Typically found in a variety of habitats within the Greater Yellowstone area. No suitable habitat on INL.

Sources: IDFG 2016; BLM 2016; USFWS 2016; 50 C.F.R. § 17, including changes dated October 2, 2015; and IDAPA 13.01.06
NA = Not applicable
Note: Only bats affected by white nose syndrome are listed here.
[1] See Table 3.5-2 for BLM category definitions.
[2] See Section 3.5.3.3 for S category definitions.

Wildlife listed as candidate species by the USFWS, or that have been assigned a conservation ranking by the ICDC or BLM that are known to occur on INL include:

- greater sage-grouse (*Centrocercus urophasianus*)
- pygmy rabbit (*Brachylagus idahoensis*)
- migratory birds (including raptors)
- bats
- large ungulates (managed as big game animals with public importance)

Field surveys were conducted in 2011 and 2012 to assess the potential for occurrence of greater sage-grouse, pygmy rabbits, and large ungulates at NRF. Methods and results of the surveys are provided in Hafla et al. 2012 and results are summarized in the sections below. Annual surveys of migratory birds and observations of bats at NRF are also summarized below.

Greater Sage-Grouse

<u>INL</u>

Greater sage-grouse (Figure 3.5-2) was removed from the federal list of candidate species by the USFWS in the fall of 2015. The greater sage-grouse is a species of conservation concern in Idaho and ranked as imperiled in the state. Greater sage-grouse have experienced long-term declines throughout their range, which includes much of the western U.S. These declines are associated in large part with the loss, fragmentation, and degradation of sagebrush habitat. Sagebrush is an important component of greater sage-grouse breeding, nesting, and winter habitat. The Idaho populations of greater sage-grouse declined at an average rate of 3 percent per year from 1965 to 1984, but declines from 1985 to 2003 averaged only 0.1 percent per year (Connelly et al. 2004). Locations of breeding habitats (leks) have become important for managing this species, due to the proximity of leks to nests. The CCA (DOE and USFWS 2014) for the INL was finalized in October 2014. The CCA establishes a Sage-grouse Conservation Area (SGCA) that limits infrastructure development and human disturbance on INL. In addition, protections are established within a 1-kilometer (0.6-mile) radius (i.e., lek buffer) of all known leks on INL, including those outside of the SGCA. Mission-critical areas, such as existing INL facilities (including NRF) are not included in the SGCA and are exempt from most conservation measures to allow DOE to fulfill its obligations and perform primary mission activities. For new infrastructure outside the SGCA and outside of existing facility footprints, best management practices are established to avoid or minimize adverse impacts to the greater sage-grouse. Annual monitoring data is evaluated by the USFWS to assess the effectiveness of conservation measures. Changes to the CCA could be made based on these evaluations.

Figure 3.5-2: Greater Sage-Grouse

NRF

Listening surveys for greater sage-grouse were conducted between April 14, and May 4, 2011 at NRF (see Hafla et al. 2012 for details). A parabolic microphone was used to detect sounds of displaying greater sage-grouse males up to 1.6 kilometers (1 mile) away (see Figure 3.5-3 for listening locations). Additional surveys for greater sage-grouse sign were conducted in June 2011 and again in June 2012 (Figure 3.5-3). The Breeding Bird Survey database for INL was researched for occurrences of greater sage-grouse around NRF and none were found. Records from 1985 through 2011 were considered (Hafla et al. 2012). No evidence of displaying male greater sage-grouse was observed during listening surveys on NRF property; therefore it is highly unlikely that a lek exists within the survey area (Figure 3.5-3). Several signs of greater sage-grouse were observed to the east and northeast of the NRF facility in the Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation and Big Sagebrush Shrubland (Figure 3.5-3). The sage-grouse sign were located in areas removed from the developed areas of NRF. The vegetation closer to the facility is largely unsuitable for sage-grouse habitat.

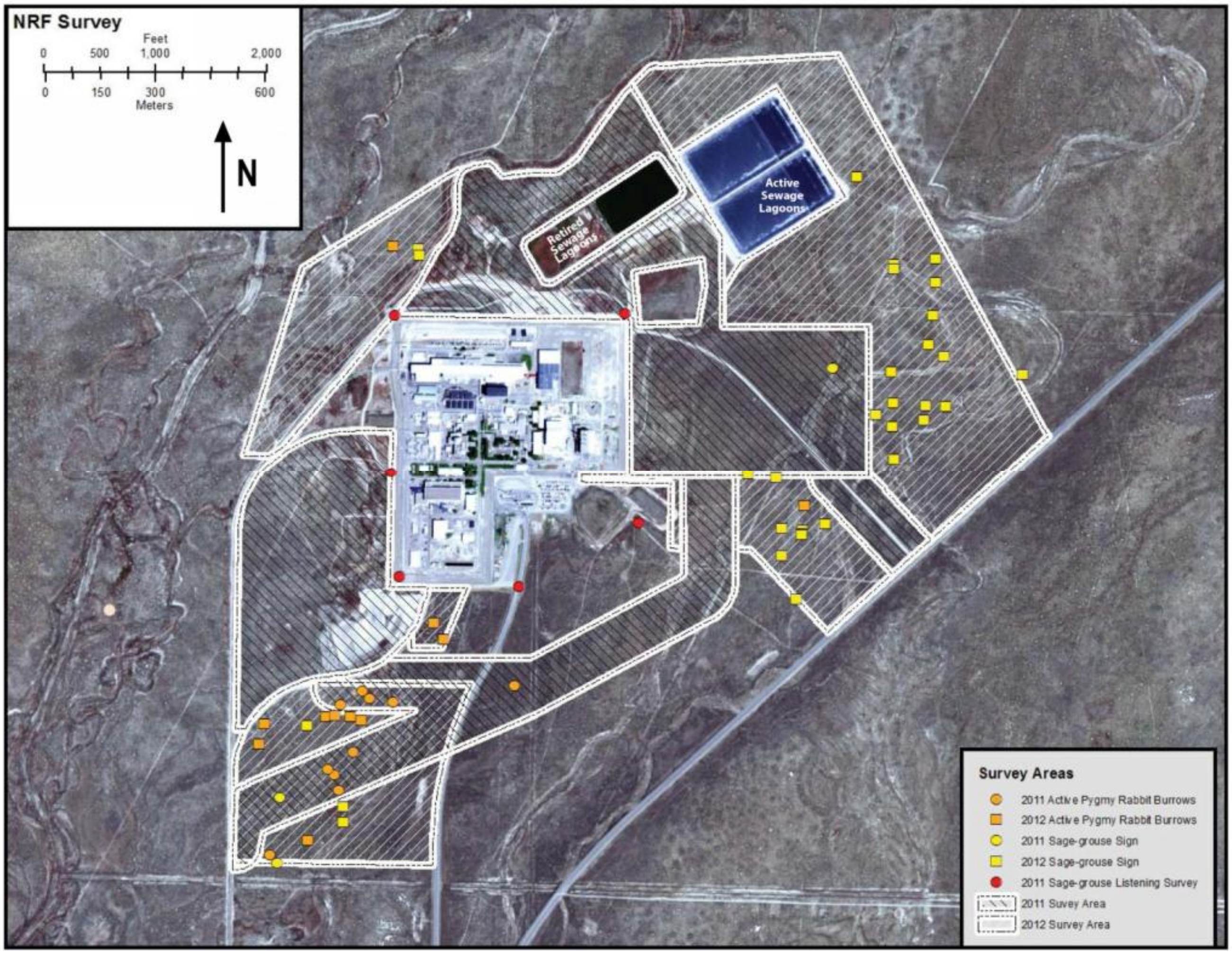


Figure 3.5-3: Greater Sage-Grouse and Pygmy Rabbit Surveys at NRF

Pygmy Rabbits

The USFWS recently announced that pygmy rabbits (Figure 3.5-4) do not warrant protection under the ESA, but they are still listed by the state as imperiled. Pygmy rabbits are sagebrush obligate species and depend on sagebrush for forage and cover (Stoller 2010). Pygmy rabbits have highly specific habitat and dietary requirements, including the need for deep, loose soils for burrow excavation and dense stands of sagebrush for food and shelter (Katzner 1997). A large proportion of their diet throughout the year consists of sagebrush, which is heavily used in the winter.

<u>INL</u>

Because areas of INL land are relatively undisturbed, it provides important habitat for pygmy rabbit populations. From 2006 to 2009, DOE conducted surveys for active pygmy rabbit burrows across INL. The survey results indicated a broad yet patchy distribution, with large areas of the site where the rabbit does not occur, and areas such as the south-east boundary where its occurrence is common. Pygmy rabbit habitat characteristics on the INL were similar to those described in other studies with mean sagebrush height of 50 centimeters (20 inches) and cover of 16 percent.

Figure 3.5-4: Pygmy Rabbit

NRF

Surveys for pygmy rabbits were conducted at NRF in 2011 and 2012 (Figure 3.5-3 and Hafla et al. 2012). Additionally, records of surveys that were conducted on INL from 2006 through 2009 were researched for occurrence of pygmy rabbits or pygmy rabbit sign (burrows, scat, tracks, etc.) in the vicinity of NRF and none were found. Thirty-three pygmy rabbit burrows were observed, with 21 of those burrows classified as active (Figure 3.5-3). One pygmy rabbit was observed. Most of the burrows were found to the southwest of the developed area of NRF in a Wyoming Big Sagebrush Shrubland community. The vegetation in the developed area is largely unsuitable for pygmy rabbit habitat.

Migratory Birds

INL

Most avian species occupying INL use both sagebrush and grassland habitats from a few days, for feeding and resting during migration, to several months, for breeding and raising young (Stoller 2005). Many bird species utilize specific habitats for foraging and reproduction. Species that primarily use sagebrush include the greater sage-grouse, sage sparrow, Brewer's sparrow, sage thrasher, and loggerhead shrike (*Lanius ludovicianus*). Species that occur mainly in grassland habitats include horned lark, western meadowlark, vesper sparrow (*Pooecetes gramineus*), and grasshopper sparrow (*Ammodramus savannarum*). Most raptors use INL indiscriminately for foraging. Nesting structures are a limiting factor in raptor population abundance and species diversity.

NRF

NRF routinely surveys areas for migratory birds. Those with federal or state rankings that have been observed at NRF are provided in Table 3.5-4. Migratory birds commonly found inside NRF perimeter fence around buildings, lawns, and trees include Brewer's blackbird (*Euphagus cyanocephalus*), Say's phoebe (*Sayornis saya*), mourning dove (*Zenaida macroura*), American robin (*Turdus migratorius*), and barn swallow (*Hirundo rustica*). Several migratory bird species are known to frequent the NRF sewage lagoons. Common species include yellow-headed blackbird (*Xanthocephalus xanthocephalus*), American coot (*Fulica americana*), Wilson's phalarope (*Phalaropus tricolor*), and several duck species. Migratory birds commonly found outside of the NRF perimeter fence, usually in sagebrush, or on top of signs or posts include northern harrier (*Circus cyaneus*), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Say's phoebe, Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), white-crowned sparrow (*Zonotrichia leucophrys*), and sage thrasher (*Oreoscoptes montanus*).

All migratory birds (including raptors) are protected under the Migratory Bird Treaty Act and some that are known to occur on INL are also listed by BLM or the state (Table 3.5-4). In addition to the Migratory Bird Treaty Act, the INL (including NRF) operates under a USFWS migratory bird take permit which regulates active nest relocation and destruction, and establishes reporting requirements.

Bats

<u>INL</u>

Nine species of bats are known to occur on INL; three are permanent (year-round residents) while six use the site on a seasonal basis (migratory). The migratory bats use caves on the INL for winter hibernacula, and for summer roosting sites, while the resident species use caves for most of the year. Caves also support a variety of insects that are food for these animals. Certain species of bats have been documented foraging at Utah juniper and sagebrush interfaces, juniper woodlands, and sagebrush habitats on the INL. Passive-acoustical monitoring stations have been used on INL to document foraging activity of bats at wastewater ponds near facilities. Bats have been detected at most of the wastewater ponds on INL. Facilities on INL are also used as habitat by bats. Buildings may be used for roosting. Landscaping, wastewater ponds, and sewage lagoons provide vertical-structure habitat, water, and foraging areas. (Whiting and Bybee 2011)

Bat species that occur on INL that are affected by white nose syndrome are listed in Table 3.5-4. White nose syndrome is a rapidly spreading lethal fungal pathogen that has decimated eastern and northeastern populations of certain bat species including the little brown myotis (*Myotis lucifugus*), the eastern small-footed myotis (*M. leibii*), and the northern long-eared myotis (*M. septentrionalis*). Since its discovery in 2006, white nose syndrome has spread from New York to Oklahoma (Kunz and Reichard 2010). The northern long-eared myotis was listed as threatened under the ESA in April 2015, and the eastern small-footed myotis is currently being reviewed for potential listing under the ESA. These two species do not occur on the INL, but their western counterparts do (western small-footed myotis (*M. ciliolabrum*) and western long-eared myotis (*M. evotis*)). The little brown myotis has been petitioned for emergency listing under the ESA due to the impacts of white nose syndrome on populations. This bat is known to occur on the INL.

In 2011, INL began implementing a monitoring program to learn more about bat ecology on the INL site and to provide baseline information on population numbers. Acoustical surveys, counts of bats in caves during the winter, and mist netting are being used to gather information on foraging, roosting, and seasonal habitat use (Whiting and Bybee 2011). The results of the monitoring program are being used to help guide development of a bat protection plan that will provide for conservation and management of bats on INL. The bat protection plan is expected to be completed and implemented in 2016.

NRF

Six bat species occur at NRF. The little brown myotis has been seen roosting in buildings at NRF. The western small-footed myotis, the western long-eared myotis, and the big brown bat (*Eptesicus fuscus*) have also been found at NRF. Two bat species that are not susceptible to white nose syndrome, silver-haired bat (*Lasionycteris noctivagans*) and hoary bat (*Lasiurus cinereus*), also occur at NRF. An acoustical monitoring station was established at the NRF active sewage lagoons in the summer of 2012 to support the INL bat monitoring program and bat protection plan.

Large Ungulates

During the wildlife surveys in 2011 and 2012 at NRF, several large ungulate signs were observed indicating transient use of undeveloped areas. These included elk, pronghorn, and mule deer. Large ungulates were not observed at NRF during INL big game surveys conducted from 1989 to 2011, indicating NRF property is not within annual migration routes or preferred habitat.

3.5.5 Wildlife of Cultural Importance

The efforts of the Shoshone-Bannock Tribes to maintain and revitalize their traditional culture are dependent on having continuing access to INL. Tribal members hunt big game and other wildlife in areas that are accessible on public lands adjacent to INL, including some areas on INL (DOE 2002c). Wildlife of potential cultural importance to the Shoshone-Bannock Tribes of the ESRP include antelope, elk, moose, deer, mule deer, waterfowl, greater sage-grouse, cottontail rabbits, jackrabbits, mountain sheep, and a variety of fish (Murphy and Murphy 1960, Emm and Singletary 2009). This list was used to determine whether wildlife of cultural importance were identified during the surveys at NRF (see Hafla et al. 2012 for survey methods and results). During the wildlife surveys, elk, pronghorn, mule deer, and greater sage-grouse sign were observed on NRF property indicating transient use by these animals. These animals are also known to occur elsewhere on INL. Several duck species are known to use the NRF active sewage lagoons. Cottontail rabbits are found on NRF property, and both cottontail and jackrabbits are common on INL.

3.5.6 Aquatic Resources

INL

Natural aquatic habitat on INL is limited to the Big Lost River, Little Lost River, and Birch Creek. All three streams are intermittent and drain into four sinks in the north-central part of the site as described in Section 3.4.1. Six species of fish have been observed within the Big Lost River. Species observed in the Big Lost River include brook trout (*Salvelinus fontinalis*), rainbow trout (*Salmo gaidneri*), mountain whitefish (*Prosopium williamsoni*), speckled dace (*Rhinichthys osculus*), shorthead sculpin (*Cottus confuses*), and kokanee salmon (*Oncorhynchus nerka*). The Little Lost River and Birch Creek, northwest and northeast of the ATR Complex, respectively, enter INL only during periods of high flow. Surveys of fish in these water bodies have not been conducted. A number of man-made liquid waste disposal ponds and ditches also provide habitat. The liquid waste disposal ponds on INL, while considered aquatic habitat, do not support fish.

NRF

There is no natural aquatic habitat at NRF. The NRF IWD and sewage lagoons (retired and active) do not contain fish populations, but do provide habitat for a variety of aquatic invertebrates.

3.5.7 Ecological Risk Assessment

INL

An INL site-wide Ecological Risk Assessment (ERA) was conducted under CERCLA to assess whether contaminants left in terrestrial and aquatic media (e.g., soils, water, and sediment) are impacting flora and fauna at a population level. It was recognized that, in addition to residual contamination, emissions from routine operations could continue to cause buildup of contaminants that could impact flora and fauna on INL. The results of the site-wide ERA were used to support selection of the "No Action Alternative with Site-Wide Ecological Monitoring" in DOE 2002f. A site-wide long-term ecological monitoring (LTEM) plan was established to verify that the "No Action Alternative" was protective of the environment. ERA data were collected from different facilities at INL from 2003 through 2009. Reference areas (areas with no contamination) and plots at each facility were established for sampling and comparison. The LTEM report issued in 2011 concluded that observed effects on ecological receptors were limited and generally attributable to natural variation (DOE 2011d). In general, the LTEM results were interpreted at the population level for INL. Population impacts from contaminants remaining in water, sediment, or soil were not detected, and it was concluded that "expectations regarding protectiveness of the no action approach to INL site-wide ERA were met" (DOE 2011d).

NRF

As part of the site-wide ERA, a Screening Level ERA and subsequent more focused ERA were conducted at NRF for WAG 8 (WEC 1997b). Several sites were investigated for known or potential contamination including the IWD and the retired sewage lagoons, and risks were calculated for six representative wildlife species. This assessment determined that the metals arsenic, lead, and mercury were the risk drivers for ecological receptors at NRF.

Radionuclides and organics were also contributors to the overall ecological risk, but the risks were determined to be very low (WEC 1997b). Therefore, no additional risk assessment was deemed necessary for radionuclide and organic compounds.

The NRF retired sewage lagoons presented the highest potential ecological risk based on accessibility, attractiveness, number of constituents present, and associated risk. The Screening Level ERA determined that deer mice, bald eagles, and mallard ducks were the primary receptors of concern. Exposure values for arsenic, lead, and mercury were calculated for each receptor and compared to a range of exposure values that resulted in no observable adverse effects to laboratory test animals. The weighted average concentration for each of these constituents at NRF was also compared to background levels. The risks associated with the exposures to the ecological receptors were characterized as low. Although there are significant uncertainties associated with this risk assessment, the results indicated that no additional actions were required due to estimated low risks to ecological receptors (WEC 1997b). Concentrations of arsenic, lead, and mercury in the active sewage lagoons are expected to be within the ranges reported for the retired sewage lagoons.

NRF was monitored under the INL site-wide LTEM in 2007 (DOE 2011d). Monitoring data collected from NRF plots generally support the conclusion that observed effects on ecological receptors were limited. For example, maximum concentrations of metals in soil samples were similar to background concentrations, and there were no toxicity effects detected in plants grown in NRF soils in the laboratory.

Concentrations of metals in water samples collected from the IWD were similar to those collected from the reference site near Mackay Reservoir, with the exceptions of barium, copper, strontium, and zinc. These four metals were elevated compared to the reference site. Comparison to the reference site is problematic for aquatic parameters because the reference area was not sampled in the same year as the IWD and data sets were highly variable. Arsenic and mercury were not detected in the IWD water during the INL site-wide LTEM, although these metals have been detected during routine sampling conducted by NRF (Table 3.5-5). With the exception of effluent samples, lead concentrations were lower than those in reference site samples. Concentrations in IWD sediment and aquatic plant samples were elevated for several metals when compared to reference area samples. For those metals identified as risk drivers, concentrations from IWD sediment and aquatic plant samples, and IWD and retired sewage lagoon effluent were elevated in some cases compared to the reference area, but not dramatically (Table 3.5-5).

Table 3.5-5: Comparison of Metal Concentrations in IWD and Retired Sewage Lagoons to Background Concentrations

Constituent	Aquatic Plants		Sediment		Effluent		
	micrograms per kilogram		milligrams per kilogram		milligrams per liter		
	Reference[1]	NRF[2]	Reference[1]	NRF[2]	Reference[3]	IWD[4]	Sewage Lagoons[4]
Arsenic[5]	90.0	140	6.1	4.4	0.0484	0.503	0.029
Lead[5]	688	668	11.8	16.4	0.0548	0.165	0.274
Mercury[5]	8.5	12.7	0.05	0.30	0.0002	0.006	0.006

Source: DOE 2011d
[1] Average of samples collected from reference site at the Mackay Reservoir in FY 2004-2006.
[2] Average of samples collected from NRF IWD in 2007.
[3] Maximum values for 2004-2006 from reference site at Mackay Reservoir.
[4] Maximum concentrations from 2005-2009.
[5] Identified as risk drivers for ecological receptors at NRF in ERA (WEC 1997b).

Radionuclides were not elevated above background or reference sites in soils, aquatic medium, or ecological receptors at NRF (DOE 2011d).

Because of the limited data set, high variability of data, and complications with comparison of aquatic parameters to the reference site, a high degree of uncertainty still exists with the NRF ERA evaluated under the INL site-wide LTEM. However, the risks associated with the exposures of ecological receptors to pollutants at NRF would still be characterized as low.

3.5.8 Wildfire

Large wildfires in 1994, 1995, 1996, 1999, 2000, and 2011 have played an important role in the ecology of INL. These fires burned about 67,100 hectares (166,000 acres) of INL and a few hundred thousand hectares (several hundred thousand acres) of public land on the ESRP managed by the BLM. The immediate effect of the fires on ecological resources at INL, aside from plants and animals that perished as a direct result of the fire, was the displacement of animals from their habitat. A longer-term concern is that non-native, invasive plant species may have a greater competitive advantage at the expense of native grasses and shrubs, especially where the ground was disturbed by fire fighting activities. Of particular concern is the loss of sagebrush, the dominant shrub of the shrub-steppe community. This plant is slow to regenerate, since it must do so from seed, whereas many other plants regenerate from underground root systems. The slow recovery of sagebrush could have a detrimental impact on greater sage-grouse. Habitat loss and fragmentation due to wildfire is one of the factors identified as a threat to greater sage-grouse persistence in the CCA (DOE and USFWS 2014).

Wildfire management alternatives for INL were assessed and selected in DOE 2003b and NRF has established actions for responding to wildfires in the Integrated Emergency Response and Contingency Plan. The potential construction sites for the proposed action are not in previously burned areas, but potential for wildfires in surrounding vegetation does exist.

3.6 Air Quality

3.6.1 Meteorology and Climatology

The ROI for meteorology and climatology is the seven-county area associated with INL: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison. Also included are the Fort Hall Reservation and the Trust Lands, home of the Shoshone-Bannock Tribes.

At INL and the surrounding area, which are located along the western edge of the ESRP, the climate is characterized as that of a semi-arid steppe. The location of INL and its surrounding area in the ESRP, including its altitude above sea level, latitude, and inter-mountain setting, affects the climate of the site. Air masses crossing the ESRP, which gather moisture over the Pacific Ocean and traverse several hundred kilometers (a few hundred miles) of mountainous terrains, have been responsible for a large percentage of any inherent precipitation. The relatively dry air and infrequent low clouds allow intense solar heating of the surface during the day and rapid radiative cooling at night. Accordingly, the climate exhibits low relative humidity, wide daily temperature swings, and large variations in annual precipitation. The meteorology and climatology at NRF is not expected to differ from those described for INL.

Annual precipitation in 2010 was light, averaging 22.4 centimeters (8.8 inches). The precipitation for 2010 was measured on INL at the CFA. The greatest short-term rainfall rates are primarily attributable to thunderstorms, which occur about 2 to 3 days per month during the summer.

The average midday relative humidity ranges from about 18 percent in the summer to about 55 percent in the winter. In January, the coldest month, the air temperature averages around -8.6 degrees Celsius (16.5 degrees Fahrenheit) and the dew point around -13.6 degrees Celsius (7.5 degrees Fahrenheit). In July, the warmest month, the air temperature averages around 20.6 degrees Celsius (69.0 degrees Fahrenheit) and the dew point about 0.8 degrees Celsius (33.4 degrees Fahrenheit). (NRC 2004)

Most locations at INL experience the predominant southwest-northeast wind flow of the ESRP, although terrain features near some locations cause variations from this flow regime. The most frequent winds are out of the southwest followed by winds out of the northeast. The orientation of the ESRP and surrounding mountain ranges results in the predominance of southwesterly winds from storms and daily solar heating. Southwesterly winds frequently create atmospheric conditions that are unstable or neutral, promote effective dispersion, and extend to a considerable depth through the atmosphere. These conditions cause the greatest dispersion of materials released from INL sources. Northeasterly winds frequently occur at night, when cool and stable air drains down the valley in a shallow layer. Atmospheric conditions at night are generally stable or neutral, and dispersion is limited.

The mountains bordering the ESRP act to channel the prevailing west winds into a southwesterly flow. This flow results because of the northeast-southwest orientation of the ESRP between the bordering mountain ranges. Average annual wind speeds at the CFA 6-meter (20-foot) tower are about 3.4 meters per second (7.5 miles per hour). Wind speeds are fastest in spring (4.1 meters per second or 9.1 miles per hour), slower in summer and fall, and slowest (2.6 meters per second or 5.9 miles per hour) in winter. The highest hourly average near-ground wind speed measured for CFA was 23 meters per second (51 miles per hour) from west-southwest, with a maximum instantaneous gust of 35 meters per second (78 miles per hour).

Severe weather includes thunderstorms, strong winds, hail, tornadoes, snow storms, and dust devils. Storms can occur throughout the year but are most prevalent in the March to October period. There may be several thunderstorms during a day. Strong winds, hail, and tornadoes can accompany severe storms, but thunderstorms tend to be less severe than those east of the Rocky Mountains, as the associated precipitation often evaporates before reaching the ground. (NRC 2011)

Considerable blowing and drifting of snow can be present during moderate to strong winds. Damage from hail has not been experienced at INL. Because crops and property have been damaged from hail in nearby areas, hail damage is possible at INL (NRC 2004).

There were six tornadoes (vortex reaches the ground) reported within INL boundaries from 1950 to 2006 (NOAA 2007). Five of these tornadoes were classified as F0 tornadoes and one was classified as an F1 tornado. No F2 or larger tornadoes that can generate projectiles were reported within the INL. In the ROI, between 2000 and 2016, there were approximately 21 tornadoes that caused a total of $3,400,000 in property damage and one injury (NCDC 2016).

Dust devils are common in the summer on INL when intense solar heating of the ground makes dust devil formation possible. The resulting dust clouds can climb to a few hundred meters (several hundred feet) in the air.

3.6.2 Air Quality Standards and Regulations

Federal and state agencies establish air quality regulations to protect the public and the environment from potential harmful effects of air pollution, and to prevent significant deterioration of air quality. These regulations were established to:

- Designate acceptable levels of pollution in ambient air.
- Establish limits on radiation doses to members of the public.
- Establish limits on air pollution emissions and resulting deterioration of air quality due to vehicles and other sources of human origin.
- Require air permits to control pollutant emissions from stationary (non-mobile) sources.
- Designate prohibitory rules, such as rules prohibiting open burning.

The Clean Air Act (CAA) and its amendments provide the regulatory framework to protect public health, including sensitive populations such as asthmatics, children, and the elderly (primary standards). They are also intended to protect public welfare by reducing air pollution effects such as decreased visibility and damage to animals, crops, vegetation, and buildings (secondary standards). The CAA Amendments of 1990 comprehensively revised existing U.S. air laws to provide expanded programs for control of toxic air pollutants, for attainment and maintenance of national ambient air quality, and for strengthened civil and criminal enforcement powers accorded to the EPA and state authorities for violations of the amendments.

The EPA has delegated regulatory authority for the majority of the CAA regulations that affect INL to the IDEQ by approving Idaho's State Implementation Plan. The State Implementation Plan directs implementation and enforcement of emission standards established by the National Ambient Air Quality Standards (NAAQS) and other requirements for air pollutants subject to the CAA. Non-radiological air emission sources at INL are regulated under the IDEQ Air Permitting Program through a Tier I (Title V) Operating Permit and permits to construct. DOE has applied to IDEQ for a synthetic minor, site-wide, air quality permit to construct (PTC) with a facility emission cap (FEC) component for the INL site. If the PTC FEC is approved, the Title V Operating Permit will be rescinded. The PTC FEC is expected to be issued in 2016 and will limit INL's potential to emit to less than major facility limits for criteria air pollutants and hazardous air pollutants. The EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations control radionuclide emission sources in Idaho. INL is also subject to DOE policy to comply with applicable regulations. DOE policy is implemented through several DOE Orders. Programs are implemented at INL to ensure compliance with air quality regulations by:

- Identifying sources of air pollutants and obtaining necessary state and federal permits.
- Providing adequate control of air pollutant emissions.
- Monitoring emissions sources to ensure compliance with air quality standards.
- Operating within permit conditions.
- Obeying prohibitory rules.

The major IDEQ and EPA air quality programs that are applicable to INL (including NRF) and permits that implement those programs are summarized below.

3.6.2.1 Non-Radiological Air Emission Standards

NAAQS

NAAQS set maximum levels of air pollutants in ambient air deemed to provide protection for human health (primary standards) and welfare (secondary standards). Limits have been established for six criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), two size ranges of particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), lead (Pb), and ozone (O_3). Certain standards apply to long-term (annual average) conditions; others are short-term and apply to conditions that persist for periods ranging from 1 hour to 3 months, depending on the toxic properties of the pollutant in question (Table 3.6-1). Idaho has established State Ambient Air Quality Standards that are substantively identical to the NAAQS for SO_2, NO_2, CO, 1-hour O_3, PM_{10}, and Pb (Table 3.6-1); however, Idaho has not established standards for 1-hour NO_2, 8-hour O_3, $PM_{2.5}$, or the rolling 3-month average for Pb.

O_3 is a criteria pollutant that is not emitted directly from INL facility sources. Instead, it forms in the atmosphere when photochemical pollutants from vehicles and industrial sources react with sunlight. These photochemical pollutants are called ozone precursors and include NO_x and VOCs. Therefore, the regulation of O_3 is affected by control of emissions of ozone precursors.

Idaho has adopted standards for fluorides; however, NRF does not have fluoride emissions. The state of Idaho monitors air quality to ensure compliance with the established standards and to determine allowable emissions of criteria air pollutants for new or modified sources. Primary and secondary standards are used by the state of Idaho to establish air quality classifications. Monitoring, limits, and reporting requirements for criteria pollutants for new or modified sources are established for INL through the permitting process. Descriptions of the criteria air pollutants and health effects are provided in Table 3.6-2.

Areas with air quality that meet the NAAQS for criteria air pollutants are designated as in “attainment,” while areas that do not meet the NAAQS for such pollutants are designated as “nonattainment.” If sufficient data are not available for determining attainment status, an area may be designated as “unclassifiable.” INL is designated as “attainment,” “better than national standards,” or “unclassifiable/attainment,” depending on the criteria pollutant being considered (40 C.F.R. § 81.313). CAA General Conformity Requirements do not apply to areas designated as “attainment,” “better than national standards,” or “unclassifiable/attainment”; therefore, these requirements do not apply to INL. The closest nonattainment area for particulate matter is Pocatello, Idaho (40 C.F.R. § 81.313), which is approximately 80 kilometers (50 miles) to the southeast of INL.

Table 3.6-1: NAAQS

Pollutant[1]	Averaging Time[2]	Standard Value		Standard Type[3]
		micrograms per cubic meter ($\mu g/m^3$)	parts per million[4] (ppm)	
CO	8-hour	1.0×10^4	9.0	P
	1-hour	4.0×10^4	3.5×10^1	P
NO_2	Annual	1.0×10^2	5.3×10^{-2}	P,S
	1-hour	1.9×10^2	1.0×10^{-1}	P
O_3	8-hour	1.5×10^2	7.5×10^{-2}	P,S
Pb	Rolling 3-month average	1.5×10^{-1}	NA	P,S
PM_{10}	24-hour	1.5×10^2	NA	P,S
$PM_{2.5}$	Annual	1.2×10^1	NA	P
	Annual	1.2×10^1	NA	S
	24-hour	3.5×10^1	NA	P,S
SO_2	3-hour	1.3×10^3	5.0×10^{-1}	S
	1-hour	2.0×10^2	7.5×10^{-2}	P

NA = Not applicable; unit of measure is not reported in ppm in the regulations
[1] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide
[2] From 40 C.F.R. §50
[3] P = primary standards, which set limits to protect public health; S = secondary standards, which set limits to protect welfare and quality of life
[4] NAAQS limits in ppm are converted to $\mu g/m^3$ using ppm × MW/24.45 × 1000, where MW = molecular weight. Equation is based on a pressure of 1 atmosphere and a temperature of 25˚C.

Table 3.6-2: Criteria Air Pollutant Descriptions and Health Effects

Pollutant	Description and Health Effects
CO	Carbon monoxide is a product of incomplete combustion, principally from automobiles and other mobile sources of pollution. Other sources of CO emissions include industrial processes such as non-transportation fuel combustion and natural sources such as wildfires. Health effects include: • Impairment of oxygen transport in the bloodstream. • Aggravation of cardiovascular disease. • Impairment of the central nervous system. • Fatigue, headache, confusion, dizziness. • Death at high levels of exposure.
NO_2	Nitrogen dioxide is a gas formed primarily from combustion of fuels. Health effects include: • Risk of acute and chronic respiratory disease.

Table 3.6-2: Criteria Air Pollutant Descriptions and Health Effects (cont.)

Pollutant	Description and Health Effects
O_3	Ozone primarily forms when photochemical pollutants from cars and industrial sources react with sunlight. These photochemical pollutants are called ozone precursors and include oxides of nitrogen (NO_x) and VOCs. Levels of O_3 are usually highest in the summer during the afternoon because of intense sunlight, warm temperatures, and the time required for ozone to form. Health effects include: • Aggravation of respiratory and cardiovascular diseases. • Impairment of cardiopulmonary function. • Eye irritation.
PM_{10} and $PM_{2.5}$	Particulates in the air are caused by a combination of wind-blown fugitive or road dust, particles that come from fuel combustion in motor vehicles and industrial sources, residential and agricultural burning, and from the reaction of NO_x, SO_x, and organics. Particulate matter with aerodynamic diameters less than or equal to 10 micrometers are referred to as PM_{10}. Particulate matter less than or equal to 2.5 micrometers are referred to as $PM_{2.5}$. Health effects include: • Aggravation of respiratory disease. • Reduced lung function. • Cough irritation. • Lung irritation. • Eye irritation.
Pb	Lead is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions to the air are ore and metal processing and leaded aviation gasoline (lead is no longer used in motor vehicle fuel). Lead smelters generally produce the highest levels of lead found in the air. Other stationary sources include waste incinerators, utilities, and lead acid battery manufacturers. Combustion and smelting processes operate at high temperatures and emit submicron particulate matter lead. Material handling and mechanical operations emit larger particles of lead. Health effects include: • Impairment of the central nervous system.
SO_2	Sulfur dioxide is a colorless reactive gas emitted largely by stationary internal or external combustion sources that burn sulfur-containing fossil fuels such as coal and oil. Natural gas contains trace amounts of SO_2. Major sources include power plants, industrial boilers, petroleum refineries, smelters, and iron and steel mills. Health effects include: • Aggravation of respiratory disease. • Reduced lung function. • Eye irritation.
VOCs[1]	VOCs are a portion of total organic compounds or gases, excluding methane (CH_4), ethane (C_2H_4), and acetone (C_3H_6O) (due to low photochemical reactivity). These compounds are regionally important due to their involvement in the photochemical reaction that produces O_3. Health effects include: • Impairment of the central nervous system. • Eye, nose, and throat irritation. • Fatigue, headache, confusion, and dizziness.

[1] Standards have not been established for VOCs. The description is included here because of their importance in O_3 formation.

Prevention of Significant Deterioration

In areas with pollutant levels below the NAAQS, the Prevention of Significant Deterioration (PSD) Program (40 C.F.R. § 52.21) places limits on the total allowable increases in ambient pollutant levels above established baseline levels for SO_2, NO_2, and PM_{10}. This prevents "polluting up to the standard." Classification of PSD areas is described in Table 3.6-3.

Table 3.6-3: Classification of PSD Areas

Classification Level	Land Type
Class I	• International parks • National wilderness areas which exceed 2023 hectares (5000 acres) • National memorial parks which exceed 2023 hectares (5000 acres) • National parks which exceed 2428 hectares (6000 acres)
Class II	• National monuments, national primitive areas, national preserves, national recreational areas, national wild and scenic rivers, national wildlife refuges, and national lakeshores or seashores which exceed 4047 hectares (10,000 acres) • National parks or national wilderness areas established after August 7, 1977 which exceed 4047 hectares (10,000 acres) • All other areas in the state
Class III	• No Class III areas have been designated.
Source: IDAPA 58.01.01.580	

Limits on increases in specific air pollutants for PSD areas are based on an existing or baseline year. Maximum allowable ambient pollutant concentration increases or increments are specified for the nation as a whole (designated Class II areas, Table 3.6-4), and more stringent increments (as well as ceilings) are prescribed for designated national resources, such as national forests and parks (designated Class I areas, Table 3.6-4). PSD increments for PM_{10}, $PM_{2.5}$, SO_2, and NO_2 have been established for Class I and II areas in the state of Idaho (Table 3.6-4). No Class III areas have been established in Idaho.

Table 3.6-4: Maximum Allowable PSD Increments

PSD Class Areas	Pollutant[1]	Averaging Time	Maximum Allowable Increment micrograms per cubic meter
Class I	PM_{10}	Annual arithmetic mean	4
		24-hour maximum	8
	$PM_{2.5}$	Annual arithmetic mean	1
		24-hour maximum	2
	SO_2	Annual arithmetic mean	2
		24-hour maximum	5
		3-hour maximum	2.5×10^1
	NO_2	Annual arithmetic mean	2.5
Class II	PM_{10}	Annual arithmetic mean	1.7×10^1
		24-hour maximum	3.0×10^1
	$PM_{2.5}$	Annual arithmetic mean	4
		24-hour maximum	9
	SO_2	Annual arithmetic mean	2.0×10^1
		24-hour maximum	9.1×10^1
		3-hour maximum	5.12×10^2
	NO_2	Annual arithmetic mean	2.5×10^1

Source: 40 C.F.R. § 51.166(c)(1): Table for Class I, II, and III areas
[1] PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; SO_2 = sulfur dioxide; and NO_2 = nitrogen dioxide

The area surrounding INL is classified as PSD Class II, designated under the CAA (42 U.S.C. § 7401) as an area with reasonable or moderately good air quality while still allowing moderate industrial growth. Craters of the Moon National Monument, which is approximately 32 kilometers (20 miles) southwest from the closest INL facility (RWMC), is classified as PSD Class I; it is the nearest area to INL where additional degradation of local air quality is severely restricted. Figure 3.6-1 shows the Class I areas and nonattainment areas in relation to the INL.

Under the CAA, the Federal Land Manager and federal official with direct responsibility for management of Federal Class I areas (e.g., Park Superintendent or Forest Supervisor) have an affirmative responsibility to protect air quality of such lands. Air quality concerns at these areas include PSD increment consumption, visibility impairment, acid deposition (e.g., sulfur and nitrogen compounds) and O_3 formation. The Federal Land Managers' Air Quality Related Work Group developed a report that provides guidance for evaluation of air pollution impacts in Federal Class I areas (FLAG 2010). The guidance provides screening methods, threshold values, and modeling methods that are accepted for evaluating Federal Class I areas.

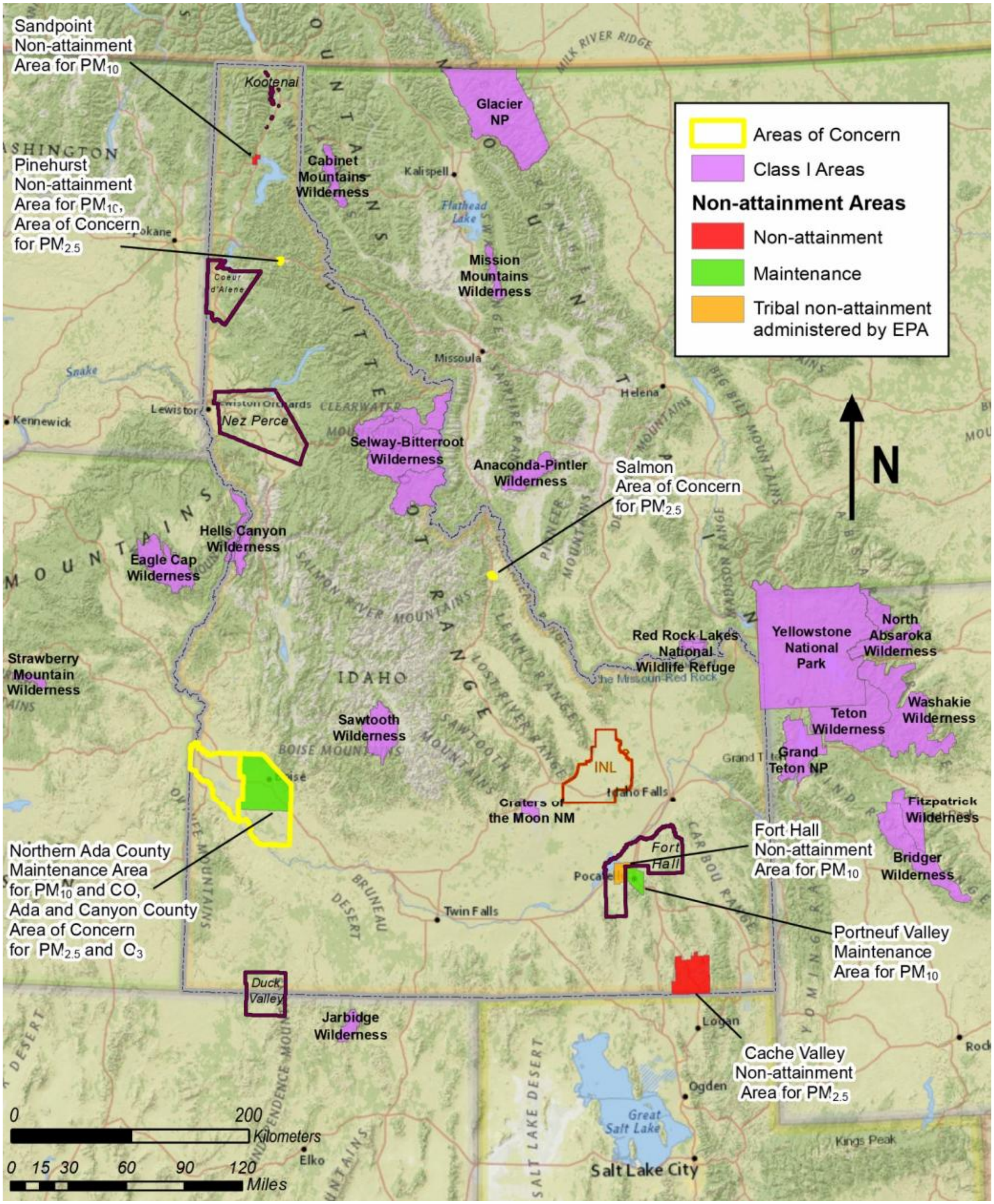


Figure 3.6-1: Air Quality Classifications for the State of Idaho

Construction or modification of any stationary source, facility, major facility, or major modification, as defined in IDAPA 58.01.01, requires evaluation to determine the expected level of emissions of all pollutants (e.g., criteria, toxic, hazardous) and evaluation of whether a Permit to Construct or Permit to Operate is required (IDAPA 58.01.01). Unless the source is specifically exempt from permitting requirements, a Permit to Construct and a Permit to Operate must be obtained prior to construction and operation. INL must comply with a site-wide Tier I Operating Permit, which contains specific emission limits and conditions for operation. This formal permitting process allows the State to determine that emissions will be adequately controlled, the source will comply with all emission standards and regulations, and public health and safety will be adequately protected.

If the expected level of emissions for a major source or major modification are significant for any air pollutants, additional ambient air quality and PSD analyses are required. Levels of significance range from about 540 kilograms (0.6 tons) per year to about 91,000 kilograms (100 tons) per year, depending on the toxic nature of the substance. Significance levels for non-radiological pollutants for the state of Idaho are presented in Table 3.6-5. Emission limits, monitoring requirements, and reporting requirements for a proposed new or modified source, facility, major facility, or major modification at INL are established and regulated through the Permit to Construct and the Tier I Operating Permit.

Table 3.6-5: Significance Levels for Non-Radiological Pollutants

Pollutant[1]		Significance Level	
		kilograms per year[2]	tons per year
CO		9.1×10^4	1.0×10^2
NO_2		3.6×10^4	4.0×10^1
O_3		3.6×10^4	4.0×10^1
Pb		5.4×10^2	6.0×10^{-1}
SO_2		3.6×10^4	4.0×10^1
Total PM		2.3×10^4	2.5×10^1
PM_{10}		1.4×10^4	1.5×10^1
$PM_{2.5}$[3] as:	Direct $PM_{2.5}$	9.1×10^3	1.0×10^1
	SO_2	3.6×10^4	4.0×10^1
	NO_2	3.6×10^4	4.0×10^1
Fluorides		2.7×10^3	3.0
Sulfuric acid mist		6.4×10^3	7.0
H_2S		9.1×10^3	1.0×10^1
Total reduced sulfur (including H_2S)		9.1×10^3	1.0×10^1
Reduced sulfur compounds (including H_2S)		9.1×10^3	1.0×10^1

Source: IDAPA 58.01.01

[1] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; SO_2 = sulfur dioxide; PM = particulate matter; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers, and H_2S = hydrogen sulfide

[2] Significance levels from the regulations were converted from tons per year to kilograms per year and then rounded to 2 significant figures.

[3] SO_2 and NO_2 are precursors for the formation of $PM_{2.5}$.

IDEQ has established rules and methodologies to estimate and control the potential human health impacts of toxic air pollutants. Toxic air pollutants include cancer-causing agents, such as arsenic, benzene, carbon tetrachloride, and formaldehyde, as well as substances that pose non-cancerous health hazards, such as fluorides, ammonia, and sulfuric acids (see IDAPA 58.01.01 for a list of toxic air pollutants). Rules and methodologies for control of toxic air pollutant emissions are implemented through air quality permit programs (i.e., Permit to Construct and Permit to Operate). Threshold emission levels have been established for about 700 toxic air pollutants, based on known or suspected toxicity of these substances. Acceptable ambient concentration levels have been defined for many toxic air pollutants by the state of Idaho. A project is eligible for a toxic air pollutant exemption if it can be shown that toxic air pollutant concentrations at the public receptor location most affected are less than the state threshold for those pollutants.

3.6.2.2 Greenhouse Gases and Climate Change

Greenhouse Gases

Greenhouse Gases (GHGs) include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These gases are transparent to solar (short-wave) radiation but opaque to long-wave radiation from the earth's surface. The net effects over time are a trapping of absorbed radiation and a tendency to warm the planet's surface and the boundary layer of the earth's atmosphere, which constitute the "greenhouse effect" (IPCC 2007). CO_2, N_2O, and CH_4 can directly affect climate change once they are released into the atmosphere. These GHGs are naturally occurring and the product of industrial activities. Other GHGs, such as the HFCs, are man-made and are present in the atmosphere exclusively due to human activities.

GHG emissions have varying heat-trapping abilities and atmospheric lifetimes (CEQ 2012). To facilitate comparison among GHGs, a Global Warming Potential (GWP) value has been assigned to each GHG. GWP represents the heat-trapping capacity of a GHG relative to CO_2, which has been assigned a GWP of 1.0, and functions as a warming "index." For example, CH_4 has a GWP of 25, so each metric ton of CH_4 emissions has 25 times the impact on global warming (over a 100-year time period) as 1 metric ton of CO_2.

Use of a single metric that embodies all GHGs has been adopted for federal reporting purposes. All GHG emissions are reported in metric tons of CO_2 equivalent (MT CO_2e). To calculate MT CO_2e, the mass of emissions of each GHG is multiplied by the appropriate GWP for that gas. GWPs for other key GHGs (40 C.F.R. § 98) are:

- CH_4 = 25
- N_2O = 298
- HFCs = 12 to 14,800
- PFCs = 7390 to 17,340
- SF_6 = 22,800

GHG sinks are those activities or processes that can remove GHGs from the atmosphere. Primary GHG sinks include carbon sequestration in oceans and other bodies of water, forests, trees in urban areas, agricultural soils, and yard trimmings and food scraps in landfills.

The U.S. is one of the top contributors to global CO_2 emissions (EPA 2013a). In 2011, U.S. GHG emissions totaled 6702 million MT CO_2e, with electricity generation being the largest emission source (about 32 percent) (EPA 2013b). Transportation is the second largest source in the U.S., accounting for about 27 percent of GHG emissions, followed by industry, agriculture, commercial, and residential sources. Total gross GHG emissions of 44 million MT CO_2e are predicted for the state of Idaho in 2020 (CCS 2008). This is approximately 0.7 percent of total U.S. emissions in 2011, making Idaho a small contributor to total U.S. GHG emissions. Idaho's primary sources of GHG emissions by sector are transportation, agriculture, residential, commercial and industrial fuel use, and electricity consumption (IDEQ 2013).

The EPA established PSD and Title V applicability permitting thresholds for GHG-emitting sources (40 C.F.R. § 51.166). IDAPA 58.01.01 incorporated the federal rule by reference. Sources are not required to obtain a permit based solely on GHG emissions. The INL currently operates under a Title V permit, but there are no GHG reporting or reduction requirements in the permit. Additionally, no state-wide reduction targets for GHG emissions are identified in IDAPA 58.01.01.

The EPA enacted regulations for mandatory reporting of GHGs in 2009 (40 C.F.R. § 98) and began implementing the requirements in 2010. Facilities with emissions greater than 25,000 MT CO_2e per year must submit an annual GHG report. The INL (including NRF) emitted greater than 25,000 MT CO_2e emissions in 2010 and was therefore subject to the mandatory reporting requirements. INL developed a GHG monitoring plan for stationary combustion and other regulated sources to meet the mandatory reporting requirements of 40 C.F.R. § 98 (DOE 2010b). NRF reported fuel oil use for boilers under this plan. From 2011 through 2015, INL emitted less than 25,000 MT CO_2e emissions and is no longer subject to the mandatory reporting requirements.

EO 13693 identifies requirements for controlling and reporting GHGs for federal agencies. The INL and NRF each have plans to control and report GHGs per EO 13693.

Climate Change

Extensive scientific literature and recent assessments of climate change have concluded that the global climate is warming (e.g., IPCC 2007, CCSP 2008, and USGCRP 2014). There is strong scientific consensus that the global warming observed over the past 50 years is from human-caused emissions of GHGs. Because of the amount of GHGs already released into the atmosphere, climate change is expected to continue if GHG emissions remain at or above current rates. GHG emissions are projected to increase world-wide. In the U.S., nationwide impacts of climate change have included increased average annual temperature of more than 1.11 degrees Celsius (2 degrees Fahrenheit) in the last 50 years; an increase in average annual precipitation, with more falling in the heaviest downpours; more frequent and intense types of extreme weather events (e.g., heat waves, regional floods, and regional drought); and rising sea levels (USGCRP 2014).

The INL is located on the ESRP which lies within the Great Basin Desert. The Great Basin Desert has warmed by 0.3 to 0.6 degrees Celsius (0.54 to 1.08 degrees Fahrenheit) in the last 100 years, and is projected to warm by an additional 5 to 10 degrees Celsius (9 to 18 degrees Fahrenheit) in the coming century (CCSP 2008). Observed and predicted changes within the Great Basin Desert include an increase in total precipitation that would be partially offset by decrease in snowpack and onset of early snowmelt and runoff (CCSP 2008). Onset of early snowmelt could impact availability of surface water or groundwater for downstream users. This could be exacerbated by more frequent or prolonged drought. Locally, extended or more frequent droughts could impact water levels in the Snake River Plain Aquifer (SRPA), potentially requiring INL to modify its groundwater monitoring networks due to decreased water levels (DOE 2012c). Regionally, lack of water resources during summer months could reduce the generating capacity of coal-fired power plants in Wyoming or of hydroelectric plants in the region, which could reduce the amount of electricity available for INL use (DOE 2012a).

Snowpack is also an important factor in soil moisture recharge, which influences plant community structure in cold desert regions. Non-native plant invasions coupled with increased temperatures and drought are expected to substantially increase wildfire frequency and intensity in sagebrush steppe communities (CCSP 2008). Results of such changes include potential for sagebrush steppe vegetation to be radically transformed into monocultures of invasive grasses over large areas.

Sagebrush dominated communities and sagebrush-obligate species may be most affected by climate change on the INL. The interaction of increasing temperature, drought, invasive species, and more frequent and severe wildfires will potentially accelerate changes to the landscape leading to threats to biological diversity and perhaps large-scale changes in plant and animal species on the INL property. Increased potential for wildfire could impact operations on the INL (including NRF) through threats to infrastructure and risk to worker health and safety. Wildfires regularly threaten INL infrastructure that supports NRF (e.g., electric transmission and roads). Historical data show that some of the INL's largest fires have occurred in recent years. Some of these fires have caused extensive ecosystem damages, but have generally done little infrastructure damage (DOE 2013c).

Predicted increases in extreme weather events due to climate change could also impact operations at INL and NRF. Extreme weather includes thunderstorms, strong winds, hail, tornadoes, snow storms, dust devils, and wildfires; all of which occur in the region. Storms at the INL can occur throughout the year but are most prevalent in the March to October period. Increases in extreme weather events could impact various systems, structures, and components on the INL and at NRF and could potentially cause safety and health impacts to workers (e.g., travel in severe storms or work in extreme hot or cold).

3.6.2.3 Radiological and Hazardous Air Pollutant Emission Standards

In addition to ambient air quality standards and PSD requirements, the CAA designates requirements for sources that emit specific substances designated as hazardous air pollutants (HAPs). These requirements are provided in NESHAP (40 C.F.R. § 61 and 63). Specific provisions of the standards (40 C.F.R. § 61, Subpart H) limit the radionuclide dose to a member of the public to 10 millirem per year. The annual dose limit applies to the maximally exposed off-site individual and is designed to protect public health with an adequate margin of safety. In addition, NESHAP requires a permit to construct or modify if all radiological air emissions from a facility could cause a dose to the public of 1 percent or more of the annual dose limit. NESHAP also establishes requirements for monitoring emissions from facility operations and analysis and reporting of dose. Airborne radiological effluents are monitored at individual INL facilities (including NRF) to comply with NESHAP requirements.

In addition to radionuclides, emissions standards have been established under NESHAP for several non-radiological HAPs including benzene, asbestos, and others, and for many activities (e.g., operation of non-emergency stationary diesel generators or operation of industrial, commercial, and institutional boilers and process heaters) that may result in emissions of HAPs. Maximum Achievable Control Technology (MACT) is specified by the EPA for various source categories. Programs or controls must be implemented to comply with the MACT prior to operation of a modified or new source. Several MACT standards have been promulgated or proposed. Most of these standards apply to major sources of HAPs, although some apply to area sources. For the NESHAP program, a major source is defined as one with the potential to emit 9072 kilograms (20,000 pounds) per year or more of any one of the 188 listed HAPs, or 22,680 kilograms (50,000 pounds) per year or more of any combination of listed HAPs. Area sources are facilities that release lesser quantities. Currently, INL is a major source for HAP emissions.

3.6.3 INL Non-Radiological Air Emissions

The ROI for the non-radiological air quality affected environment discussion for the INL includes public roads and receptors as defined for the INL by IDEQ (IDEQ 2011), and Federal Class I areas that could be impacted by INL emissions (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park).

The population of the ESRP is exposed to air pollutants from a variety of sources including agricultural and industrial activities, residential wood burning, wind-blown dust, and vehicle exhaust. Many of the activities at INL also emit air pollutants. Sources for criteria, toxic, and HAPs at INL include fuel oil-fired boilers, diesel engines, emergency diesel generators (EDGs), miscellaneous small gasoline, diesel, and propane combustion sources, and miscellaneous chemical usage. The boilers are used to generate steam for heating facilities and are the main source of non-radiological air emissions at INL. Diesel engines are used at the ATR Complex to generate electricity for reactor operations. EDGs are used at all INL facilities as emergency electrical power sources, and periodic testing contributes to criteria and toxic air pollutant emissions. The miscellaneous combustion sources include non-vehicle sources such as small portable generators, air compressors, and welders. These sources for all INL facilities (including NRF) were used to generate an estimate of total INL emissions (Appendix E, Section E.2). Federal GHG reporting requirements and GHG emissions for INL are also addressed. Non-radiological emissions specific to NRF operations are discussed in Section 3.6.4.

3.6.3.1 Criteria Pollutants

Routine off-site monitoring for non-radiological air pollutants has generally only been performed for PM_{10}. Monitoring for PM_{10} was performed at communities beyond the site boundary and reported in INL Annual Site Environmental Reports from 2004 through 2007 (ESER 2004, ESER 2005, ESER 2006, and ESER 2007). Collection areas included Rexburg, Blackfoot, and Atomic City. The upper limit of the annual range for 24-hour average PM_{10} concentration was well below the regulatory limit of 150 micrograms per cubic meter at the three off-site monitoring locations (Table 3.6-6).

Some monitoring data have been collected by the National Park Service at the Craters of the Moon National Monument. The monitoring program has shown that applicable standards O_3, SO_2, and PM_{10} concentrations have not been exceeded (NPS 2003).

Five-year (2005-2009) maximum actual criteria pollutant emissions for INL are provided in Table 3.6-7. Maximum potential emissions estimated for an earlier EIS (DOE 2002c) are also shown. The maximum potential emissions were calculated to bound all potential INL emissions in DOE 2002c, and are overestimates of actual emissions (e.g., assumes all sources are operating all the time at maximum capacity). Additionally, more sources were operational in the 1990’s, and higher sulfur content fuels were used. The 5-year maximums for 2005 through 2009 were based on actual fuel use reported by INL facilities and represent realistic estimates of air pollutant emissions. See Appendix E for emissions inputs, assumptions, and calculations. This was done to develop a reasonable baseline for cumulative assessments of emissions from INL facilities and the proposed action, and to focus on those pollutants that could be impacted by the proposed action (i.e., those generated from burning fossil fuels).

Table 3.6-6: PM_{10} Concentrations at Off-Site Monitoring Locations

Location	Annual Range of Concentrations of PM_{10}[1] Particulates for 24-hour Averaging Times (micrograms per cubic meter)			
	2004	2005	2006	2007
Rexburg	1.9 – 47.6 (n^2 = 61)	0.0 – 44.8 (n = 61)	0.0 – 44.8 (n = 55)	1.8 – 32.0 (n = 43)
Blackfoot	1.5 – 39.3 (n = 61)	0.07 – 42.4 (n = 60)	0.30 – 50.1 (n = 60)	1.5 – 21.0 (n = 43)
Atomic City	0.0 – 84.5 (n = 61)	0.1 – 52.5 (n = 59)	0.0 – 66.1 (n = 58)	0.2 – 8.0 (n = 43)

Sources: ESER 2005, ESER 2006, ESER 2007, and ESER 2008
[1] Particulate matter ≤10 micrometers
[2] n = number of valid 24-hour samples collected for the year. From 2004 to 2006, samples were collected from January through December. In 2007, data collection ceased after March.

Table 3.6-7: INL Criteria and PSD Pollutant Emissions

Pollutant[2]	Emissions					
	1996[1]		1997[1]		Five-Year[3] Maximum	
	kilograms per year	pounds per year	kilograms per year	pounds per year	kilograms per year	pounds per year
CO	1.6×10^5	3.5×10^5	4.5×10^5	9.9×10^5	2.4×10^4	5.3×10^4
NO_x	2.2×10^5	4.9×10^5	8.2×10^5	1.8×10^6	9.0×10^4	2.0×10^5
Pb	1.5	3.3	5.6×10^2	1.2×10^3	2.6	5.7
PM_{10}	1.8×10^5	4.0×10^5	1.8×10^5	4.0×10^5	3.8×10^3	8.5×10^3
$PM_{2.5}$	NA		NA		3.6×10^3	8.0×10^3
SO_x	1.2×10^5	2.6×10^5	9.1×10^4	2.0×10^5	8.9×10^2	2.0×10^3
VOCs	1.6×10^4	3.5×10^4	2.7×10^4	6.0×10^4	2.4×10^3	5.2×10^3

[1] Source: DOE 2002c
[2] CO = carbon monoxide; NO_x = nitrogen oxides (including nitrogen dioxide); Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤ 2.5 micrometers; SO_x = sulfur oxides; VOCs = volatile organic compounds, excluding methane
[3] 2005-2009
NA = emission monitoring and reporting was not required

Atmospheric dispersion modeling for criteria air pollutant concentrations at INL public receptor locations was done with AERMOD, version 11103 (EPA 2004a) using meteorological data processed through AERMET, version 06341 preprocessor (EPA 2004b). See Appendix E for the AERMOD modeling methodology. Five years of meteorological data were used from the Idaho Falls Airport (surface data), the Boise International Airport (upper-air data), and INL on-site data. The surface and upper-air data sets were obtained from the IDEQ. The on-site data were obtained from NOAA. INL public receptor locations (Figure 3.6-2) were obtained from IDEQ (IDEQ 2011). The total number of INL public receptor locations modeled was 1374. Craters of the Moon National Monument receptors were obtained from the National Park Service (Appendix E). The near field (≤ 50 kilometers (31 miles) from the source) Federal Class I area for Craters of the Moon was modeled using AERMOD. The modeling results for INL criteria pollutant concentrations for ambient air are shown in Table 3.6-8.

The ratios of criteria air pollutant concentrations to NAAQS (Table 3.6-8) show that the standards are met for all pollutants and averaging times at INL and Craters of the Moon National Monument public receptor locations. If the ratio is less than 1.0, then the limits are not exceeded. Most of the ratios are much less than 1.0. However, for the 1-hour NO_2 concentration, the ratios are about 0.5 for INL, indicating about 50 percent of the limit was reached at the maximum receptor locations. For demonstrating compliance with the 1-hour average NO_2 concentration, Tier 3 methodology (EPA 2011b) allows comparison of the 8th highest 1-hour average NO_2 concentration to the standard. Figure 3.6-2 shows a contour plot for the 8th highest 1-hour average NO_2 concentration modeled for INL. The red star south of CFA in Figure 3.6-2 is the point of maximum concentration at INL receptors.

Measured 98th percentile 1-hour average NO_2 concentrations on INL were 19 and 27 micrograms per cubic meter for the second and third quarters of 2003, respectively (INL 2013a). The hourly measured NO_2 concentrations reflect spikes during commuting hours related to vehicle emissions. Although these measurements do not represent a full year of data, they do provide some limited validation that the modeled concentrations are a reasonable estimate of the expected NO_2 concentrations in the air from INL operations.

Table 3.6-8: Predicted Maximum Criteria Air Pollutant Concentrations at Public Receptor Locations for INL Facilities

Pollutant[1]	Applicable Standard[2] micrograms per cubic meter	Averaging Time	Concentration micrograms per cubic meter	Ratio of Pollutant Concentration to Standard[3]
CO	4.0×10^{4}	1-hour	8.3×10^{1}	2.1×10^{-3}
	1.0×10^{4}	8-hour	1.3×10^{1}	1.3×10^{-3}
NO_2	1.9×10^{2}	1-hour	8.7×10^{1}	4.6×10^{-1}
	1.0×10^{2}	Annual	6.9×10^{-1}	6.9×10^{-3}
Pb	1.5×10^{-1}	Monthly[4]	9.9×10^{-5}	6.6×10^{-4}
PM_{10}	1.5×10^{2}	24-hour	2.0	1.3×10^{-2}
$PM_{2.5}$	3.5×10^{1}	24-hour	6.5×10^{-1}	1.9×10^{-2}
	1.2×10^{1}	Annual	3.6×10^{-2}	3.0×10^{-3}
SO_2	2.0×10^{2}	1-hour	6.4	3.2×10^{-2}
	1.3×10^{3}	3-hour	1.4×10^{1}	1.1×10^{-2}

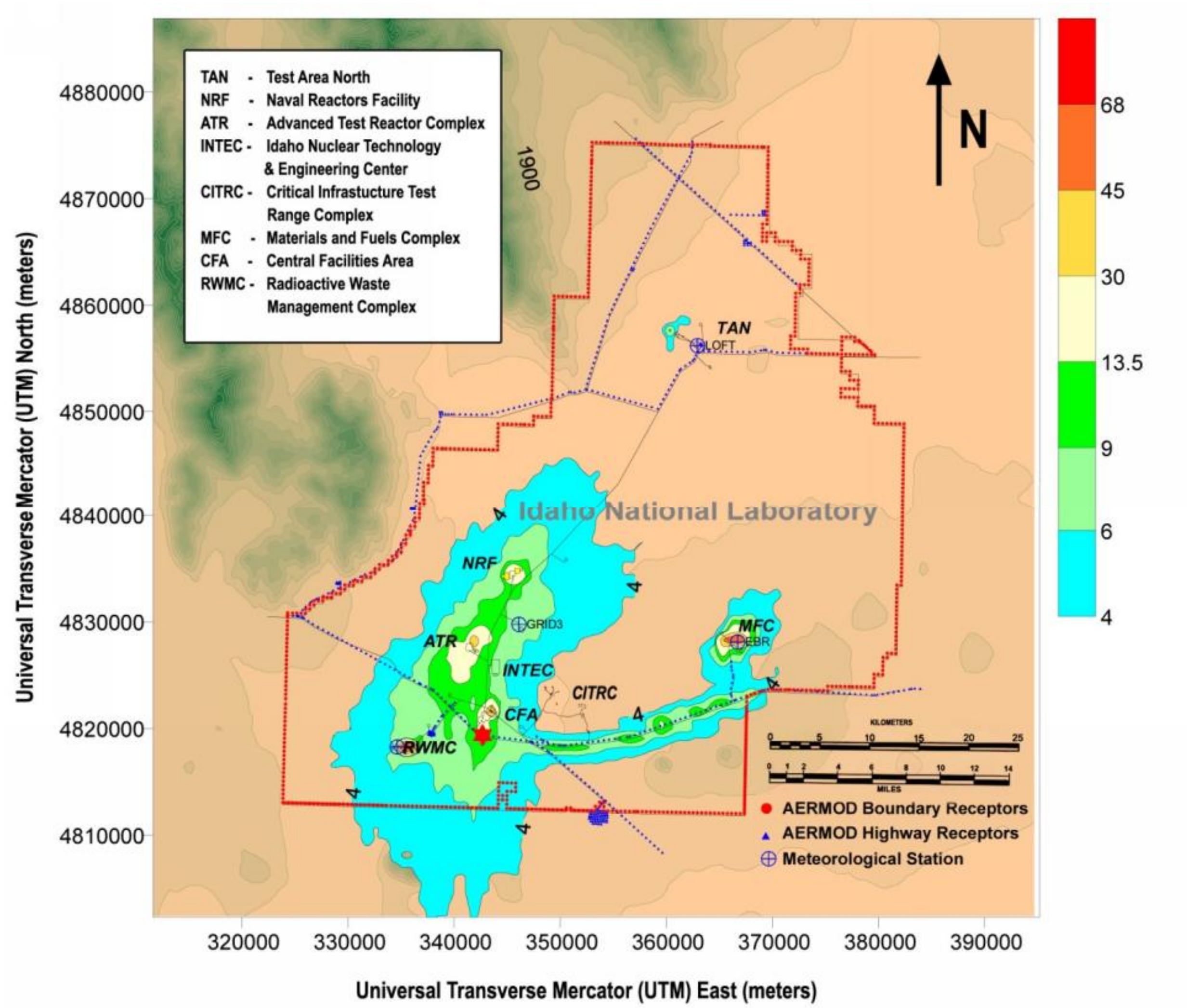
Source: INL 2013a

[1] CO=carbon monoxide; NO_2 = nitrogen dioxide; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide

[2] From 40 C.F.R. § 50

[3] A ratio less than 1.0 indicates standard was not exceeded.

[4] Conservatively modeled as monthly instead of quarterly.



Source: INL 2013a
Notes:
Red dots delineating the INL boundary and blue dots delineating highways represent public receptor locations.
The red star south of CFA is the point of maximum concentration for INL receptors.
Concentrations are provided in micrograms per cubic meter.

Figure 3.6-2: Contour Plot Showing 8th Highest 1-Hour NO_2 Concentrations Modeled for INL and INL Public Receptors

3.6.3.2 PSD

PSD increment consumption was modeled for the INL Class II area using AERMOD (EPA 2004a) as described above for criteria and toxic pollutants. AERMOD was also used for the Craters of the Moon near field Class I areas. CALPUFF, version 5.8 (Scire et al. 2000a and Scire et al. 2000b), was used to model PSD increment consumption at far field (greater than 50 kilometers (31 miles) from the source) Federal Class I areas. See Appendix E for modeling methodology. Increment consumption was based on emissions from all INL facilities, including those that were operational prior to PSD baseline dates. INL is classified as an existing major stationary source under the PSD program. The modeling results are provided in Table 3.6-9 and Table 3.6-10.

The ratios of maximum predicted increment consumed to allowable PSD increments at INL receptor locations (Class II area) are much less than 1.0, indicating PSD standards are met (Table 3.6-9). Ratios for Craters of the Moon National Monument, Yellowstone National Park, and Grand Teton National Park are also well below 1.0 (Table 3.6-10), indicating that PSD increments are met at Class I areas.

Table 3.6-9: PSD Increment Consumption at Class II Areas at INL

Pollutant[1]	Averaging Time	Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads	Ratio[2] of Maximum Increment Consumed to Allowable PSD Increment
		micrograms per cubic meter		
NO_2	Annual	2.5×10^{1}	6.9×10^{-1}	2.8×10^{-2}
PM_{10}	24-hour	3.0×10^{1}	2.0	6.5×10^{-2}
	Annual	1.7×10^{1}	3.6×10^{-2}	2.1×10^{-3}
$PM_{2.5}$	24-hour	9	6.5×10^{-1}	7.3×10^{-2}
	Annual	4	3.6×10^{-2}	8.9×10^{-3}
SO_2	3-hour	5.12×10^{2}	1.4×10^{1}	2.7×10^{-2}
	24-hour	9.1×10^{1}	2.1	2.3×10^{-2}
	Annual	2.0×10^{1}	9.2×10^{-3}	4.6×10^{-4}

Source: INL 2013a
[1] NO_2 = nitrogen dioxide; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide
[2] A ratio of 1 or greater would indicate that the pollutant concentration met or exceeded NAAQS, respectively.

Table 3.6-10: PSD Increment Consumption at Class I Areas by INL Sources

Pollutant[1]	Averaging Time	Allowable PSD Increment	Craters of the Moon National Monument				Yellowstone National Park		Grand Teton National Park	
			Maximum Predicted Increment Consumed		Ratio[2] of Maximum Increment Consumed to Allowable PSD Increment		Maximum Predicted Increment Consumed	Ratio[2] of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed	Ratio[2] of Maximum Increment Consumed to Allowable PSD Increment
		micrograms per cubic meter					micrograms per cubic meter		micrograms per cubic meter	
			Near Field[3]	Far Field[4]	Near Field[3]	Far Field[4]				
NO_2	Annual	2.5	2.1×10^{-2}	1.4×10^{-2}	8.4×10^{-3}	5.4×10^{-3}	3.9×10^{-4}	1.6×10^{-4}	2.1×10^{-4}	8.2×10^{-5}
PM_{10}	24-hour	8	1.5×10^{-2}	1.8×10^{-2}	1.8×10^{-3}	2.2×10^{-3}	1.2×10^{-3}	1.5×10^{-4}	9.1×10^{-4}	1.1×10^{-4}
	Annual	4	3.9×10^{-4}	2.6×10^{-3}	9.8×10^{-5}	6.4×10^{-4}	1.5×10^{-4}	3.7×10^{-5}	9.1×10^{-5}	2.3×10^{-5}
$PM_{2.5}$	24-hour	2	9.4×10^{-3}	2.0×10^{-2}	4.7×10^{-3}	1.0×10^{-2}	2.0×10^{-3}	9.9×10^{-4}	1.6×10^{-3}	7.7×10^{-4}
	Annual	1	3.7×10^{-4}	3.1×10^{-3}	3.7×10^{-4}	3.1×10^{-3}	2.4×10^{-4}	2.4×10^{-4}	1.5×10^{-4}	1.5×10^{-4}
SO_2	3-hour	2.5×10^{1}	8.7×10^{-2}	8.3×10^{-3}	3.5×10^{-3}	3.3×10^{-4}	8.7×10^{-4}	3.5×10^{-5}	5.7×10^{-4}	2.3×10^{-5}
	24-hour	5	1.3×10^{-2}	2.2×10^{-3}	2.7×10^{-3}	4.5×10^{-4}	2.6×10^{-4}	5.1×10^{-5}	1.7×10^{-4}	3.3×10^{-5}
	Annual	2	2.1×10^{-4}	2.1×10^{-4}	1.1×10^{-4}	1.0×10^{-4}	1.8×10^{-5}	8.9×10^{-6}	1.1×10^{-5}	5.6×10^{-6}

Source: INL 2013a and INL 2013c
[1] NO_2 = nitrogen dioxide; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide
[2] A ratio of 1 or greater would indicate that the pollutant concentration met or exceeded NAAQS, respectively.
[3] Near field: ≤ 50 kilometers from source.
[4] Far field: > 50 kilometers from source. Yellowstone and Grand Teton National Parks are far field sites.

3.6.3.3 Toxic Air Pollutants

Toxic emissions are evaluated on a source-by-source basis, not on a cumulative basis like the criteria pollutants. INL has not been required to apply for any IDAPA Toxic Permits to Construct. Toxic emissions from fuel combustion (boilers and generators at INL facilities) for new sources are captured under air permits or restrictions on operations due to categorical exemptions from permitting (DOE 2005b). Exemptions from permitting are granted when the emissions source satisfies various criteria (e.g., uncontrolled emission rates below threshold values).

Actual toxic air emissions data from boilers, EDGs, and miscellaneous combustion sources for all of INL are provided in Table 3.6-11. Emissions are based on 5 years (2005-2009) of data (Appendix E). The list of toxic air pollutants in Table 3.6-11 is not exhaustive for INL and includes only those that could be emitted as part of the proposed action.

Table 3.6-11: INL Toxic Emissions

Pollutant Name	Emissions	
	kilograms per year	pounds per year
Non-Carcinogens		
Acrolein (C_3H_4O)	3.0×10^{-1}	6.7×10^{-1}
Ammonia (NH_3)	1.2×10^{3}	2.6×10^{3}
Chromium (Cr)	6.5×10^{-1}	1.4
Copper (Cu)	1.3	2.9
Ethylbenzene (C_8H_{10})	9.3×10^{-2}	2.0×10^{-1}
Manganese (Mn)	1.3	2.9
Naphthalene ($C_{10}H_8$)	4.0	8.8
Selenium (Se)	3.2	7.1
Toluene (C_7H_8)	1.5×10^{1}	3.2×10^{1}
Xylenes (C_8H_{10})	4.0	8.7
Zn as zinc oxide (ZnO)	1.1	2.4
Carcinogens		
1,3-Butadiene (C_4H_6)	7.4×10^{-1}	1.6
Acetaldehyde (C_2H_4O)	1.8	4.1
As as arsenic trioxide (As_2O_3)	1.2	2.5
Benzene (C_6H_6)	1.5×10^{1}	3.4×10^{1}
Be as beryllium oxide (BeO)	1.8	4.0
Cd as cadmium oxide (CdO)	7.4×10^{-1}	1.6
Formaldehyde (HCOH)	9.2×10^{1}	2.0×10^{2}
Nickel (Ni)	6.5×10^{-1}	1.4
Polycyclic aromatic compounds (PACs)[1]	1.9×10^{-1}	4.2×10^{-1}

[1] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene

Atmospheric dispersion modeling for toxic air pollutant concentrations at INL public receptor locations was done with AERMOD, as described in Appendix E. The maximum modeled toxic air pollutant concentrations at pubic receptor locations for INL are shown in Table 3.6-12.

Table 3.6-12: INL Toxic Air Pollutant Concentrations and Limits

Averaging Time	Pollutant Name	Standard[1]	Concentration at INL Receptor Locations	Ratio of Concentration to Standard
		micrograms per cubic meter		
	Non-Carcinogens			
24-hour	Acrolein (C_3H_4O)	1.25×10^{1}	6.9×10^{-4}	5.6×10^{-5}
24-hour	Ammonia (NH_3)	9.0×10^{2}	2.5×10^{-1}	2.8×10^{-4}
24-hour	Chromium (Cr)	2.5×10^{1}	1.3×10^{-4}	5.2×10^{-6}
24-hour	Copper (Cu)	5.0×10^{1}	2.6×10^{-4}	5.2×10^{-6}
24-hour	Ethylbenzene (C_8H_{10})	2.175×10^{4}	2.0×10^{-5}	9.2×10^{-10}
24-hour	Manganese (Mn)	2.5×10^{2}	2.6×10^{-4}	1.0×10^{-6}
24-hour	Naphthalene ($C_{10}H_8$)	2.5×10^{3}	1.1×10^{-3}	4.2×10^{-7}
24-hour	Selenium (Se)	1.000×10^{1}	6.5×10^{-4}	6.5×10^{-5}
24-hour	Toluene (C_7H_8)	1.875×10^{4}	4.0×10^{-3}	2.1×10^{-7}
24-hour	Xylene (C_8H_{10})	2.175×10^{4}	2.7×10^{-3}	1.2×10^{-7}
24-hour	Zinc (ZnO)	5.0×10^{2}	2.1×10^{-4}	4.3×10^{-7}
	Carcinogens			
Annual	1,3-Butadiene (C_4H_6)	3.6×10^{-3}	5.4×10^{-6}	1.5×10^{-3}
Annual	Acetaldehyde (C_2H_4O)	4.5×10^{-1}	2.4×10^{-5}	5.4×10^{-5}
Annual	Arsenic (As_2O_3)	2.3×10^{-4}	2.5×10^{-5}	1.1×10^{-1}
Annual	Benzene (C_6H_6)	1.2×10^{-1}	1.1×10^{-4}	9.1×10^{-4}
Annual	Beryllium (BeO)	4.2×10^{-3}	3.9×10^{-5}	9.2×10^{-3}
Annual	Cadmium (CdO)	5.6×10^{-4}	1.6×10^{-5}	2.9×10^{-2}
Annual	Formaldehyde (HCOH)	7.7×10^{-2}	2.1×10^{-3}	2.7×10^{-2}
Annual	Nickel (Ni)	4.2×10^{-3}	1.4×10^{-5}	3.3×10^{-3}
Annual	Polycyclic aromatic compounds (PACS)[2]	3.0×10^{-4}	1.2×10^{-6}	4.1×10^{-3}

Source: INL 2013a
[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens)
[2] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene

The ratios of pollutant concentrations to IDAPA standards (Table 3.6-12) show that the standards are met for all pollutants and averaging times at INL public receptor locations. The concentrations of all toxic air pollutants are less than the standards.

3.6.3.4 Visibility, Deposition, and Ozone Screening at Federal Class I Areas

Initial emissions screening for INL facilities for SO_x, H_2SO_4 (sulfuric acid), NO_x, and PM_{10} per guidance in FLAG 2010 showed that the threshold for regional haze, acid deposition, and O_3 analyses for far field Federal Class I areas was not exceeded, indicating further analysis would not be required. See Appendix E, Section E.4.2 for screening analysis. This eliminated the need for additional evaluation of regional haze, acid deposition, or O_3 at Grand Teton National Park, Yellowstone National Park, and Craters of the Moon National Monument far field areas.

VISCREEN (EPA 1992a) and guidance in FLAG 2010 were used to evaluate plume visibility at the Craters of the Moon National Monument near field areas. VISCREEN is a conservative screening model that uses worst case meteorological conditions, coupled with the wind blowing in the direction of the Class I area, and release from a ground-level point source (e.g., stack, see Appendix E). VISCREEN Level 1 screening threshold values to evaluate plume visibility stipulated in FLAG 2010 are light extinction (ΔE) < 2.0 and the absolute value of color contrast ($|C|$) < 0.05. Color contrast values vary between negative and positive and depend on the scattering of blue light from particles present in the atmosphere. The addition or subtraction of blue light results in visibility impairment due to a diminished contrast between objects and the sky. ΔE is always positive and represents light extinction (absorption) caused mainly by the presence of NO_2 in the atmosphere. Changes in light extinction and contrast are estimated for INL facilities (including NRF) and compared to established threshold values. Results of VISCREEN Level 1 screening methods for INL facility emissions are provided in Table 3.6-13. The results show that values for INL facilities are below threshold values for ΔE and $|C|$.

Table 3.6-13: INL Visibility Impacts at Near Field Areas of Craters of the Moon National Monument

Background	Theta	Azimuth	Distance		Alpha	ΔE[1] (Threshold Value = 2)	|C|[2] (Threshold Value = 0.05)
			kilometers	miles			
Sky	10	145	45.6	28.3	24	0.74	0.006
Sky	140	145	45.6	28.3	24	0.64	0.01
Terrain	10	84	32	19.9	84	0.34	0.002
Terrain	140	84	32	19.9	84	0.13	0.001

[1] Change in light extinction (i.e., absorption) caused mainly by the presence of NO_2 in the atmosphere when viewed against different backgrounds (e.g., sky and terrain). Screening values less than 2 indicate ΔE would not be impacted.
[2] Absolute value of color contrast which represents impacts on blue light due to scattering from particulates in the atmosphere when viewed against different backgrounds. Screening values less than 0.05 indicate color contrast would not be impacted.

In Federal Class I areas, controlling NO_x emissions is thought to be the most effective means of limiting O_3 concentrations (FLAG 2010). For near field areas of Craters of the Moon National Monument, the maximum modeled NO_2 concentration for INL facilities (including NRF) is 2.1×10^{-2} micrograms per cubic meter. The ratio of maximum NO_2 increment consumption to allowable PSD increment is 8.4×10^{-3}, indicating negligible ozone formation at near field areas of Craters of the Moon National Monument from INL emissions.

3.6.3.5 GHG Emissions

GHG emissions for INL activities (including operations conducted in Idaho Falls) are provided in Table 3.6-14. Federal reporting guidance (CEQ 2012) establishes requirements for reporting Scope 1, Scope 2, and Scope 3 GHG emissions, and for establishing a baseline for FY 2008 from which to document GHG reductions. Scope 1 are direct emissions from production of electricity, heat, cooling, or steam; mobile combustion sources (e.g., automobiles, ships, and aircraft); fugitive emissions within an agency's organizational boundary; and process emissions from laboratory activities. Scope 2 emissions are indirect or shared emissions associated with consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 3 emissions include all other indirect emissions not included in Scope 2 (e.g., business air/ground travel, employee commuting, contracted solid waste disposal, contracted wastewater treatment, subcontractor emissions, and transmission and distribution losses associated with purchased electricity).

Table 3.6-14: INL GHG Emissions

	Scope 1 and 2 Emissions		Scope 3 Emissions		Total Emissions	
	MT CO_2e	U.S. Tons	MT CO_2e	U.S. Tons	MT CO_2e	U.S. Tons
FY 2008 Baseline	140,950	155,369	35,206	38,808	176,156	194,177
FY 2010	90,811	100,101	23,082	25,443	113,893	125,544
FY 2011	112,398	123,896	28,460	31,372	140,858	155,268
FY 2012	112,484	123,991	26,761	29,499	139,245	153,490
FY 2013	97,746	107,745	22,287	24,567	120,033	132,312
FY 2014	104,304	114,974	23,190	25,562	127,494	140,537
FY 2015	93,761	103,353	24,868	27,412	118,629	130,765
Note: The totals do not include NRF GHG emissions. Table 3.6-21 provides NRF GHG emissions. Sources: INL 2011a, DOE 2012a, DOE 2012d, DOE 2013c, DOE 2014c, DOE 2015b						

DOE established goals for GHG emission reductions to meet the requirements of EO 13693 (Planning for Federal Sustainability in the Next Decade) (DOE 2015b). INL and NRF are subject to the goals established by DOE. These goals are:

- 50 percent reduction in combined Scope 1 and 2 GHG emissions by Fiscal Year 2025 from a FY 2008 baseline
- 25 percent reduction in Scope 3 GHG emissions by Fiscal Year 2025 from a Fiscal Year 2008 baseline.

In 2015, the INL was on track for meeting these goals with a 33.5 percent reduction in combined Scope 1 and 2 emissions, and a 29.4 percent reduction in Scope 3 emissions compared to the FY 2008 baseline. Purchased electricity is the largest contributor to the Scope 1 and 2 emissions followed by stationary combustion emissions and fugitive emissions from the on-site landfill. Transportation fuel was the largest source of GHG emissions within Scope 3, followed by business air travel. (DOE 2015b)

3.6.4 NRF Non-Radiological Air Emissions

The ROI for the non-radiological air quality affected environment discussion for NRF includes public roads and receptors as defined for the INL by IDEQ (IDEQ 2011), and Federal Class I areas that could be impacted by NRF emissions (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park).

NRF uses three fuel oil-fired boilers to generate steam for heating several of the facility buildings, including ECF. The boilers are the major source of non-radiological air emissions at NRF. In addition to boiler operations, NRF has four large EDGs that are used as emergency electric power sources. Periodic testing of the generators and operation of other miscellaneous fuel combustion sources (e.g., small diesel engines, gasoline engines, and propane heaters) contribute to non-radiological air emissions at NRF.

3.6.4.1 Criteria and PSD Air Pollutants

Five-year maximum criteria pollutant emissions from all NRF sources for 2005 through 2009 are provided in Table 3.6-15. It is estimated that one-third of the steam produced by the NRF boilers and 45 percent of emergency power (during EDG testing) is used by ECF (Appendix E). Estimated ECF emissions are also provided in Table 3.6-15. ECF emissions are used as described in Appendix E to estimate future emissions for the proposed action. Criteria pollutant concentrations and PSD increment consumption at receptor locations modeled for INL that are reported in Table 3.6-8, Table 3.6-9, Table 3.6-10, and Table 3.6-12 included NRF emissions because NRF operates and reports under the INL site-wide Tier I Operating Permit. Therefore, pollutant concentrations at receptor locations that are specific to NRF are not modeled separately. Air pollutant emission contributions from NRF to the INL total are provided below.

Table 3.6-15: Five-Year Maximum Criteria and PSD Air Pollutant Emissions for NRF and ECF

Pollutant[1]	NRF 5-Year[2] Maximum Emissions[3]		ECF 5-Year[2] Maximum Emissions[4, 5]	
	kilograms per year	pounds per year	kilograms per year	pounds per year
CO	2.1×10^3	4.5×10^3	5.7×10^2	1.2×10^3
NO_x	8.2×10^3	1.8×10^4	2.2×10^3	4.9×10^3
Pb[6]	3.6×10^{-1}	8.0×10^{-1}	1.2×10^{-1}	2.7×10^{-1}
PM_{10}	7.7×10^2	1.7×10^3	2.2×10^2	4.8×10^2
$PM_{2.5}$	5.7×10^2	1.3×10^3	1.5×10^2	3.3×10^2
SO_x[7]	1.8×10^2	4.0×10^2	2.0×10^1	4.4×10^1

[1] CO = carbon monoxide; NO_x = nitrogen oxides, includes NO_2, NO, and N_2O; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; SO_x = sulfur oxides, includes SO_2 and SO_3. PSD pollutants are NO_x, PM_{10}, $PM_{2.5}$, and SO_x.
[2] 2005-2009
[3] Includes boilers, EDGs, and miscellaneous sources
[4] Includes boilers and EDGs (miscellaneous sources are not associated with ECF operations)
[5] Derived from NRF emissions as described in Appendix E, Section E.2.2.1
[6] Lead is reported as lead monoxide (PbO)
[7] 3-year averages (2007-2009) are presented for SO_x. Prior to 2007, fuel with higher sulfur content was used to power the boilers.

Concentrations of criteria pollutants and PSD increments consumed at public receptor locations and Federal Class I areas were modeled separately for the ECF as described in Appendix E. The contributions to INL total concentrations reported above that are attributable to ECF are provided in Table 3.6-16 and Table 3.6-17. The ratios of criteria air pollutant concentrations to NAAQS (Table 3.6-16) show that the standards are met for all pollutants and averaging times at INL, with ratios that are significantly less than 1.0.

The ratios of maximum predicted increment consumed to the allowable PSD increments at INL receptor locations (Class II area) that are attributable to ECF are significantly less than 1.0, indicating PSD standards are met (Table 3.6-17). Ratios for Craters of the Moon National Monument, Yellowstone National Park, and Grand Teton National Park that are attributable to ECF are also well below 1.0 (Table 3.6-17), indicating that PSD increments are met at Class I areas.

Table 3.6-16: Predicted Maximum Criteria Air Pollutant Concentrations at INL Public Receptor Locations for the ECF

Pollutant[1]	Applicable Standard[2] (micrograms per cubic meter)	Averaging Time	Concentration (micrograms per cubic meter)	Ratio of Pollutant Concentration to Standard[3]
CO	4.0×10^{4}	1-hour	3.7	9.2×10^{-5}
	1.0×10^{4}	8-hour	4.8×10^{-1}	4.8×10^{-5}
NO_2	1.9×10^{2}	1-hour	3.3	1.8×10^{-2}
	1.0×10^{2}	Annual	1.9×10^{-2}	1.9×10^{-4}
Pb	1.5×10^{-1}	Monthly[4]	8.5×10^{-7}	5.7×10^{-6}
PM_{10}	1.5×10^{2}	24-hour	2.5×10^{-2}	1.7×10^{-4}
$PM_{2.5}$	3.5×10^{1}	24-hour	9.7×10^{-3}	2.8×10^{-4}
	1.2×10^{1}	Annual	4.8×10^{-4}	4.0×10^{-5}
SO_2	2.0×10^{2}	1-hour	1.5×10^{-2}	7.2×10^{-5}
	1.3×10^{3}	3-hour	9.6×10^{-3}	7.4×10^{-6}

Source: INL 2013a
[1] CO=carbon monoxide; NO_2 = nitrogen dioxide; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide
[2] From 40 C.F.R. § 50
[3] A ratio less than 1.0 indicates standard was not exceeded.
[4] Conservatively modeled as monthly instead of quarterly.

Table 3.6-17: Predicted Maximum PSD Increment Consumption at INL Class II Areas and the Near Field Class I Area for the ECF

Pollutant[1]	Averaging Time	Allowable PSD Increment[2] (micrograms per cubic meter)	Predicted Maximum Increment Consumed (micrograms per cubic meter)	Ratio of Maximum Increment Consumed to Allowable PSD Increment
INL Class II				
NO_2	Annual	2.5×10^{1}	1.9×10^{-2}	7.5×10^{-4}
PM_{10}	24-hour	3.0×10^{1}	2.5×10^{-2}	8.4×10^{-4}
	Annual	1.7×10^{1}	6.1×10^{-4}	3.6×10^{-5}
$PM_{2.5}$	24-hour	9	9.7×10^{-3}	1.1×10^{-3}
	Annual	4	4.8×10^{-4}	1.2×10^{-4}
SO_2	3-hour	5.12×10^{2}	9.6×10^{-3}	1.9×10^{-5}
	24-hour	9.1×10^{1}	1.6×10^{-3}	1.8×10^{-5}
	Annual	2.0×10^{1}	4.8×10^{-5}	2.4×10^{-6}
Craters of the Moon Near Field Area				
NO_2	Annual	2.5	2.0×10^{-3}	7.9×10^{-4}
PM_{10}	24-hour	8	8.0×10^{-4}	1.0×10^{-4}
	Annual	4	3.4×10^{-5}	8.5×10^{-6}
$PM_{2.5}$	24-hour	2	4.5×10^{-4}	2.2×10^{-4}
	Annual	1	2.8×10^{-5}	2.8×10^{-5}

Table 3.6-17: Predicted Maximum PSD Increment Consumption at INL Class II Areas and the Near Field Class I Area for the ECF (cont.)

Pollutant[1]	Averaging Time	Allowable PSD Increment[2]	Predicted Maximum Increment Consumed	Ratio of Maximum Increment Consumed to Allowable PSD Increment
		micrograms per cubic meter		
SO_2	3-hour	2.5×10^{1}	3.2×10^{-4}	1.3×10^{-5}
	24-hour	5	5.7×10^{-5}	1.1×10^{-5}
	Annual	2	3.0×10^{-6}	1.5×10^{-6}

Source: INL 2013a and INL 2013c
[1] NO_2 = nitrogen dioxide; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide
[2] 40 CFR 51.166(c)(I): Table for Class I, II, and III

3.6.4.2 Toxic Air Pollutants

The primary sources of toxic air pollutant emissions at NRF are the boilers, EDGs, and miscellaneous combustion sources. Five-year (2005 through 2009) maximum toxic air pollutant emissions for all NRF sources and ECF are provided in Table 3.6-18. As with the criteria pollutant emissions, it is estimated that one third of the steam generated by the boilers and 45 percent of emergency power (during EDG testing) is used by ECF.

Atmospheric dispersion modeling for ECF toxic air pollutant concentrations at INL public receptor locations was done with AERMOD, as described in Appendix E. The maximum modeled toxic air pollutant concentrations at pubic receptor locations for ECF are shown in Table 3.6-19. The ratios of pollutant concentrations to IDAPA standards (Table 3.6-19) show that the standards are met for ECF for all pollutants and averaging times at INL public receptor locations. The concentrations of all toxic air pollutants are significantly less than the standards.

Table 3.6-18: Five-Year Maximum Toxic Air Emissions for NRF and ECF

Pollutant	NRF 5-Year[1] Maximum Emissions[2]		ECF 5-Year Maximum Emissions[3]	
	kilograms per year	pounds per year	kilograms per year	pounds per year
Non-Carcinogens				
Acrolein (C_3H_4O)	3.9×10^{-2}	8.5×10^{-2}	1.0×10^{-3}	2.2×10^{-3}
Ammonia (NH_3)	2.2×10^{2}	4.8×10^{2}	7.3×10^{1}	1.6×10^{2}
Chromium (Cr)	1.1×10^{-1}	2.5×10^{-1}	3.7×10^{-2}	8.2×10^{-2}
Copper (Cu)	2.3×10^{-1}	5.0×10^{-1}	7.5×10^{-2}	1.6×10^{-1}
Ethylbenzene (C_8H_{10})	1.7×10^{-2}	3.8×10^{-2}	5.8×10^{-3}	1.3×10^{-2}
Manganese (Mn)	2.3×10^{-1}	5.0×10^{-1}	7.5×10^{-2}	1.6×10^{-1}
Naphthalene ($C_{10}H_8$)	3.8×10^{-1}	8.4×10^{-1}	1.2×10^{-1}	2.6×10^{-1}
Selenium (Se)	5.6×10^{-1}	1.2	1.9×10^{-1}	4.1×10^{-1}
Toluene (C_7H_8)	1.9	4.3	6.0×10^{-1}	1.3
Xylenes (C_8H_{10})	2.0×10^{-1}	4.3×10^{-1}	3.5×10^{-2}	7.7×10^{-2}
Zn as zinc oxide (ZnO)	1.9×10^{-1}	4.1×10^{-1}	6.2×10^{-2}	1.4×10^{-1}
Carcinogens				
1,3-Butadiene (C_4H_6)	2.7×10^{-2}	5.9×10^{-2}	5.0×10^{-3}	1.1×10^{-2}
Acetaldehyde (C_2H_4O)	3.1×10^{-1}	6.8×10^{-1}	3.2×10^{-3}	7.2×10^{-3}
As as arsenic trioxide (As_2O_3)	2.0×10^{-1}	4.4×10^{-1}	6.5×10^{-2}	1.5×10^{-1}
Benzene (C_6H_6)	6.5×10^{-1}	1.4	1.2×10^{-1}	2.6×10^{-1}
Be as beryllium oxide (BeO)	3.1×10^{-1}	6.9×10^{-1}	1.0×10^{-1}	2.3×10^{-1}
Cd as cadmium oxide (CdO)	1.3×10^{-1}	2.8×10^{-1}	4.3×10^{-2}	9.4×10^{-2}
Formaldehyde (HCOH)	1.7×10^{1}	3.8×10^{1}	5.6	1.2×10^{1}
Nickel (Ni)	1.1×10^{-1}	2.5×10^{-1}	3.7×10^{-2}	8.2×10^{-2}
Polycyclic Aromatic Compounds (PACs)[4]	1.1×10^{-2}	2.5×10^{-2}	2.6×10^{-3}	5.7×10^{-3}

[1] 5-year data are for 2005-2009
[2] Includes boilers, EDGs, and miscellaneous sources
[3] Includes boilers and EDGs (miscellaneous sources are considered to be associated with construction and not with ECF operations)
[4] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene

Table 3.6-19: ECF Toxic Air Pollutant Concentrations and Limits

Averaging Time	Pollutant	Standard[1] (micrograms per cubic meter)	Concentration at INL Receptor Locations (micrograms per cubic meter)	Ratio of Concentration to the Standard
Non-Carcinogens				
24-hour	Acrolein (C_3H_4O)	1.25×10^{1}	2.2×10^{-6}	1.8×10^{-7}
24-hour	Ammonia (NH_3)	9.0×10^{2}	4.8×10^{-3}	5.3×10^{-6}
24-hour	Chromium (Cr)	2.5×10^{1}	3.1×10^{-6}	1.2×10^{-7}
24-hour	Copper (Cu)	5.0×10^{1}	6.1×10^{-6}	1.2×10^{-7}
24-hour	Ethylbenzene (C_8H_{10})	2.175×10^{4}	3.8×10^{-7}	1.7×10^{-11}
24-hour	Manganese (Mn)	2.5×10^{2}	6.1×10^{-6}	2.5×10^{-8}
24-hour	Naphthalene ($C_{10}H_8$)	2.5×10^{3}	3.9×10^{-5}	1.5×10^{-8}
24-hour	Selenium (Se)	1.000×10^{1}	1.5×10^{-5}	1.5×10^{-6}
24-hour	Toluene (C_7H_8)	1.875×10^{4}	9.9×10^{-5}	5.3×10^{-9}
24-hour	Xylene (C_8H_{10})	2.175×10^{4}	5.5×10^{-5}	2.5×10^{-9}
24-hour	Zinc (ZnO)	5.0×10^{2}	5.1×10^{-6}	1.0×10^{-8}
Carcinogens				
Annual	1,3-Butadiene (C_4H_6)	3.6×10^{-3}	1.9×10^{-7}	5.2×10^{-5}
Annual	Acetaldehyde (C_2H_4O)	4.5×10^{-1}	1.2×10^{-7}	2.7×10^{-7}
Annual	Arsenic (As_2O_3)	2.3×10^{-4}	1.6×10^{-7}	7.0×10^{-4}
Annual	Benzene (C_6H_6)	1.2×10^{-1}	3.8×10^{-6}	3.1×10^{-5}
Annual	Beryllium (BeO)	4.2×10^{-3}	2.5×10^{-7}	5.9×10^{-5}
Annual	Cadmium (CdO)	5.6×10^{-4}	1.0×10^{-7}	1.8×10^{-4}
Annual	Formaldehyde (HCOH)	7.7×10^{-2}	1.2×10^{-5}	1.6×10^{-4}
Annual	Nickel (Ni)	4.2×10^{-3}	9.0×10^{-8}	2.1×10^{-5}
Annual	Polycyclic Aromatic Compounds (PACS)[2]	3.0×10^{-4}	4.4×10^{-8}	1.5×10^{-4}

Source: INL 2013a
[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens)
[2] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene

3.6.4.3 Visibility, Deposition, and Ozone Screening at Federal Class I Areas

Initial emissions screening for ECF for SO_x, H_2SO_4, NO_x, and PM_{10} per guidance in FLAG 2010 showed that the threshold for regional haze, acid deposition, and O_3 analyses for far field Federal Class I areas was not exceeded, indicating further analysis was not required. See Appendix E, Section E.4.2 for screening analysis. This eliminated the need for additional evaluation of regional haze, acid deposition, or O_3 due to ECF emissions at Grand Teton National Park, Yellowstone National Park, and Craters of the Moon National Monument far field areas.

As described above for INL (Section 3.6.3.4), VISCREEN (EPA 1992a) and guidance in FLAG 2010 were used to evaluate plume visibility impacts from ECF emissions at the Craters of the Moon National Monument near field areas. Results of VISCREEN Level 1 screening methods for ECF emissions are provided in Table 3.6-20. The results show that values for the ECF are well below threshold values for ΔE and |C|.

Table 3.6-20: ECF Visibility Impacts at Near Field Areas Craters of the Moon National Monument

Background	Theta	Azimuth	Distance		Alpha	ΔE[1] (Threshold Value = 2)	|C|[2] (Threshold Value = 0.05)
			kilometers	miles			
Sky	10	145	45.6	28.3	24	0.02	0.0
Sky	140	145	45.6	28.3	24	0.025	0.001
Terrain	10	84	32	19.9	84	0.034	0.0
Terrain	140	84	32	19.9	84	0.005	0.0

[1] Change in light extinction (i.e., absorption) caused mainly by the presence of NO_2 in the atmosphere when viewed against different backgrounds (e.g., sky and terrain). Screening values less than 2 indicate ΔE would not be impacted.
[2] Absolute value of color contrast which represents impacts on blue light due to scattering from particulates in the atmosphere when viewed against different backgrounds. Screening values less than 0.05 indicate color contrast would not be impacted.

In Federal Class I areas, controlling NO_x emissions is thought to be the most effective means of limiting O_3 concentrations (FLAG 2010). For near field areas of Craters of the Moon National Monument, the maximum modeled NO_2 concentration for ECF is 2.0×10^{-3} micrograms per cubic meter. The ratio of maximum NO_2 increment consumption to allowable PSD increment is 7.9×10^{-4}, indicating negligible ozone formation at near field areas of Craters of the Moon National Monument from ECF emissions.

3.6.4.4 GHG Emissions

GHG Scope 1, Scope 2, and Scope 3 emissions for the NRF FY 2008 baseline and FY 2010 through 2015 are provided in Table 3.6-21.

Table 3.6-21: NRF GHG Emissions

	Scope 1 and 2 Emissions		Scope 3 Emissions		Total Emissions	
	MT CO_2e	U.S. Tons	MT CO_2e	U.S. Tons	MT CO_2e	U.S. Tons
FY 2008 Baseline	15,572	17,165	3220	3549	18,792	20,714
FY 2010	14,003	15,436	3190	3516	17,193	18,952
FY 2011	13,248	14,603	2443	2693	15,691	17,296
FY 2012	11,428	12,597	2440	2690	13,868	15,287
FY 2013	11,982	13,208	3313	3652	15,295	16,860
FY 2014	12,307	13,566	3281	3617	15,588	17,183
FY 2015	10,298	11,351	2897	3193	13,195	14,545

The NRF FY 2025 GHG emission reduction goals are the same as the DOE goals described in Section 3.6.3.5. In FY 2015, there was a decrease in GHG emissions compared to the previous years. NRF was on track for meeting the goal for reduction in combined Scope 1 and 2 emissions with a 33 percent reduction compared to the FY 2008 baseline. Purchased electricity is the largest contributor to the Scope 1 and 2 emissions followed by fuel oil used for heating. There was a decrease of 10 percent in Scope 3 emissions compared to the FY 2008 baseline. Transportation fuel (employee commuting) is the largest contributor to Scope 3 emissions.

3.6.5 INL Radiological Air Emissions

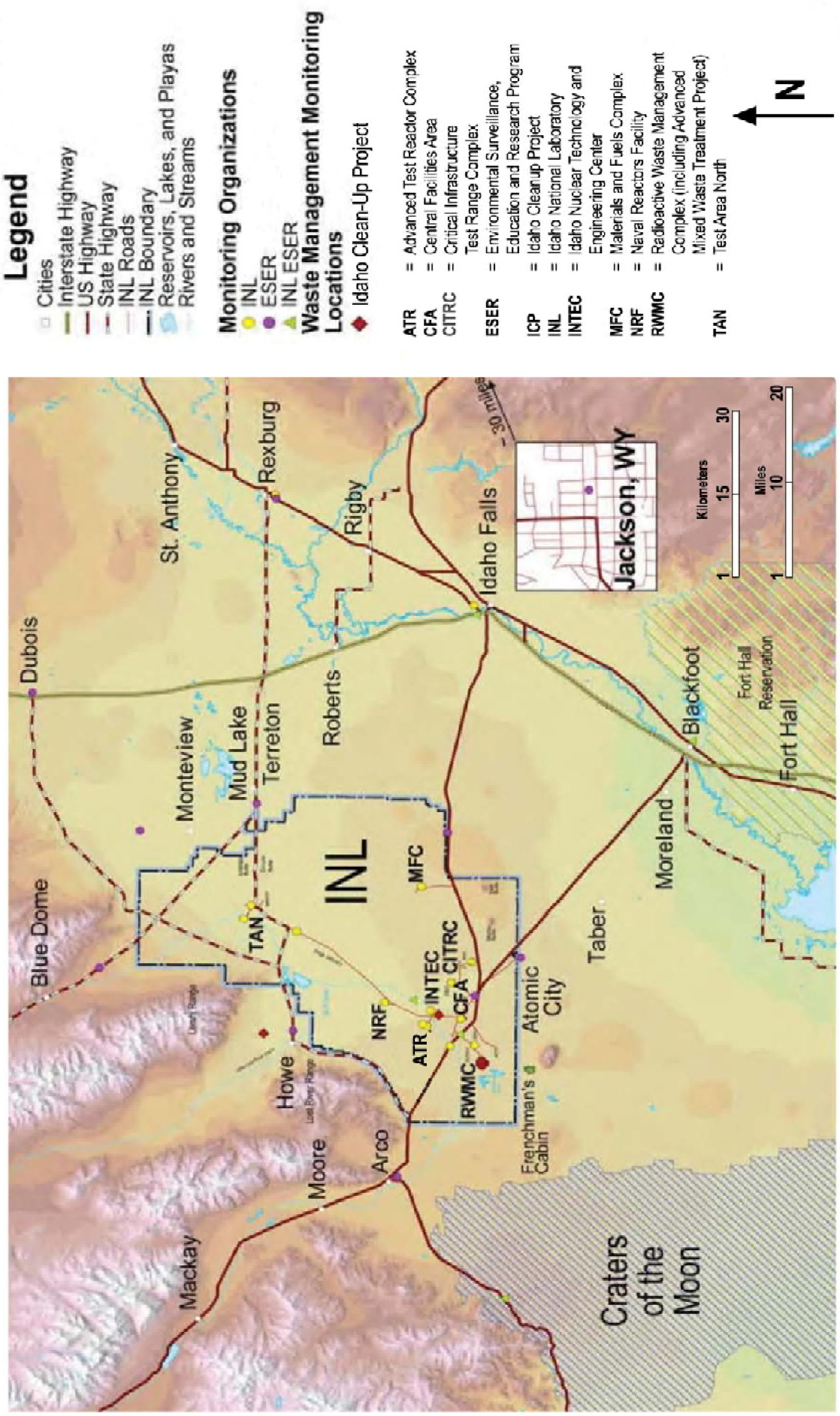
The ROI for the INL radiological air quality affected environment includes the INL area monitoring network shown in Figure 3.6-3.

The major source of radiation exposure for the ESRP is natural background radiation. Sources of radioactivity related to INL operations contribute a small amount of additional exposure. Background radiation is discussed in Section 3.13.2.

INL operations can release radioactivity to the air directly (e.g., through facility stacks or vents) or indirectly (e.g., by resuspension of radioactivity from contaminated soils). Emissions from INL facilities include radioisotopes of noble gases (argon, krypton, and xenon) and iodine; particulate fission products (e.g., strontium, and cesium); radionuclides formed by neutron activation, such as ^{3}H, ^{14}C, and ^{60}Co; and heavy elements, such as uranium, thorium, and plutonium, and their decay products. These radionuclides can be transported to nearby populations by pathways such as air, soil, plants, animals, and groundwater. For INL operations, air is considered the primary radionuclide transport pathway to members of the general public.

Extensive monitoring and assessment activities are conducted to characterize existing radiological conditions for INL and the surrounding environment (ESER 2010). Monitoring is performed by INL contractors, the state of Idaho's INL Oversight Program, and the ESER contractor. The monitoring network established by INL contractors and the ESER contractor is shown in Figure 3.6-3. Monitoring results are used to calculate the dose received by the maximally exposed individual member of the public from INL airborne releases. Radiological air emissions and their resulting dose to the public are presented in annual NESHAP reports, which are used to demonstrate INL compliance with regulatory dose standards.

Table 3.6-22 shows the total Curies released from facilities on INL in 2009. Most of these emissions (greater than 85 percent) are in the form of noble gases (argon, krypton, and xenon), which are inert or unreactive with other elements. Most of the remaining percentage of emissions is in the form of ^{3}H.



Source: ESER 2010

Figure 3.6-3: INL Air Quality Monitoring Network

Table 3.6-22: Total Curies Released From INL Facilities in 2009

^{3}H	^{85}Kr	Noble Gases[1]	Short-Lived Fission and Activation Products[2]	Fission and Activation Products[3]	Total Radioiodine[4]	Total Radiostrontium[5]	Total Uranium[6]	Plutonium[7]	Other Actinides[8]	Other[9]
Curies per year										
1030	4594	1690	0.98	0.18	0.11	9.66×10^{-3}	5.13×10^{-6}	2.21×10^{-2}	1.83×10^{-3}	7.62

Source: ESER 2010

[1] Noble gases with half-lives less than 40 days released = ^{41}Ar, ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{131m}Xe, ^{133m}Xe, and ^{138}Xe

[2] Fission products and activation products (T ½ < 3 hours) = ^{139}Ba, ^{138}Cs, ^{88}Rb, ^{89}Rb, ^{91m}Y, etc.

[3] Fission products and activation products (T ½ > 3 hours) = ^{14}C, ^{36}Cl, ^{58}Co, ^{60}Co, ^{51}Cr, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{55}Fe, ^{203}Hg, ^{103}Ru, ^{106}Ru, ^{95}Zr, etc.

[4] Total radioiodine = ^{125}I, ^{128}I, ^{129}I, ^{131}I, ^{132}I, ^{133}I, ^{134}I, ^{135}I

[5] Total radiostrontium = ^{85}Sr, ^{89}Sr, ^{90}Sr, ^{91}Sr, and ^{92}Sr

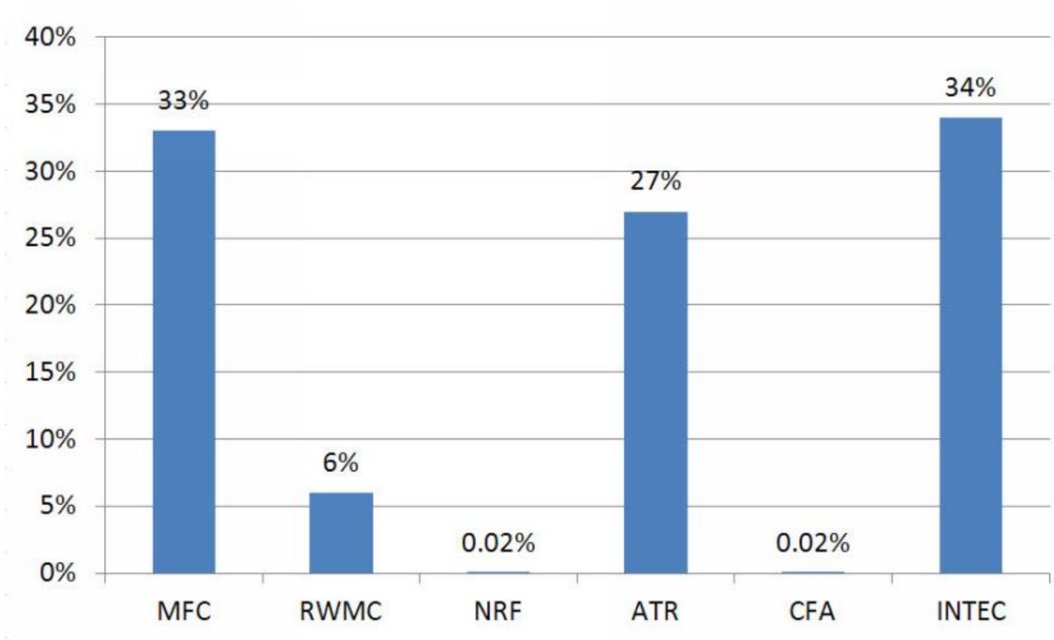
[6] Total uranium = ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U

[7] Plutonium = ^{236}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu

[8] Other actinides = ^{241}Am, ^{243}Am, ^{249}Cf, ^{242}Cm, ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{247}Cm, ^{248}Cm, ^{237}Np, ^{239}Np, ^{231}Pa, ^{227}Th, ^{229}Th, ^{230}Th, ^{231}Th, ^{232}Th, and ^{234}Th

[9] Other = radioisotopes of other elements that are not noble gases, activation or fission products, or actinides

Emissions from INTEC, MFC, and the ATR Complex accounted for approximately 94 percent of the total Curies released in 2009 (Figure 3.6-4). RWMC accounted for about 6 percent of the total Curies released. The estimated contributions of NRF and CFA to the total Curies released in 2009 were only 0.02 percent per facility. Emission sources for the major contributing facilities and NRF are described below.



Source: ESER 2010

Figure 3.6-4: Facility Contributions to Total INL Airborne Radionuclide Releases

INTEC operations accounted for about 34 percent of the total INL radiological air emissions in 2009 (Figure 3.6-4). Operations at this facility are associated with liquid waste operations (e.g., Tank Farm Facility, Evaporator Tank System, Process Equipment Waste Evaporator, and Liquid Effluent Treatment and Disposal) and naval spent nuclear fuel management (e.g., naval spent nuclear fuel shipments, handling, and wet and dry storage). Sources of radioactive air emissions at INTEC include decontamination and debris treatment activities, sample analysis, site remediation, remote-handled transuranic (TRU) waste management, radiological and hazardous waste storage, equipment maintenance, and miscellaneous emissions from radioactively contaminated buildings. Most of the INTEC emissions contained krypton-85 (^{85}Kr) (Table 3.6-22), which is associated with the nuclear fuel cycle. The dose potentially received from ^{85}Kr would be primarily external exposure to the skin from ^{85}Kr released to the air. (ESER 2010)

MFC operations accounted for about 33 percent of the total INL radiological air emissions in 2009 (Figure 3.6-4). Facility operations that are primarily responsible for radiological air emissions include spent fuel treatment at the Fuel Conditioning Facility and waste characterization at the Hot Fuel Examination Facility. Additional activities that account for minor releases of gaseous and particulate radionuclides include laboratory analyses, waste handling, and storage and maintenance operations. In 2009, ^{85}Kr was released when drums containing spent nuclear fuel were vented. This release accounted for about one-third of the total estimated INL airborne emissions for 2009, and partially accounted for the increase in total Curies released in 2009 compared to previous years (Table 3.6-22). (ESER 2010)

The ATR Complex operations accounted for about 27 percent of the total INL radiological air emissions in 2009 (Figure 3.6-4). Most of the radiological air emissions were associated with operation of the ATR, and included noble gases (primary emissions), radioiodines, and other mixed fission and activation products (Table 3.6-22). Other sources of radiological air emission at the ATR Complex include shielded cell operations, sample analysis, site remediation, research and development activities, and decontamination and demolition activities. In 2009, decontamination and demolition activities included contaminated equipment removal, demolition of contaminated structures, closure of mixed waste tank systems, and characterization and disposal of contaminated soils. (ESER 2010)

RWMC operations accounted for about 6 percent of the total INL radiological air emissions in 2009 (Figure 3.6-4). Emissions were primarily from the Subsurface Disposal Area cleanup and included waste retrieval and operation of several units that extract VOCs from the subsurface. The Advanced Mixed Waste Treatment Project at the RWMC also contributes to radiological air emissions. Activities include retrieval, characterization, and treatment of TRU waste, alpha-contaminated low-level mixed waste, and low-level mixed waste. In 2009, the emissions from RWMC were mainly ^{3}H (Table 3.6-22). The dose potentially received from ^{3}H would primarily be internal exposure from inhalation and ingestion of ^{3}H. (ESER 2010)

3.6.6 NRF Radiological Air Emissions

The ROI for NRF radiological air emissions includes individuals within an 80.5-kilometer (50-mile) radius of NRF.

As noted in Chapter 1, naval spent nuclear fuel is designed to retain all fission products, including radioactive gases. Very minute amounts of fission products are created from fission that occurs naturally in trace amounts of uranium in the fuel cladding. Because these amounts are extremely small, there is no need for special equipment to remove or control fission products. The source of most radioactive contamination from routine naval spent nuclear fuel handling operations is from corrosion products that were activated by radiation. Although the corrosion products tightly adhere to the outside surface of naval spent nuclear fuel, some corrosion products may become dislodged from the naval spent nuclear fuel during shipment or handling.

Special controls are used in areas where radioactive corrosion products could become airborne to prevent their release into the environment. Airborne radioactivity is controlled during maintenance so contamination is contained and respiratory equipment is not normally required. To prevent exposure of personnel to airborne radioactivity, and to prevent radioactivity from escaping to the atmosphere, work that might generate airborne contamination is performed inside sealed containments. These containments are ventilated to the atmosphere only through High-Efficiency Particulate Air (HEPA) filters. These HEPA filters are tested in place following installation and routinely thereafter. The procedure, called dioctylphthalate (DOP) testing, is performed using 0.7-micron diameter DOP aerosol particles. In accordance with federal specifications, the installed filter must exhibit an overall collection efficiency of 99.95 percent or higher to be acceptable for use. Airborne radioactivity surveys are performed regularly in radioactive work areas. If airborne radioactivity above the limit is detected in occupied areas, work that might be causing airborne radioactivity is immediately stopped, and the potential source is identified and contained. (NNPP 2011d)

NRF operations accounted for only 0.02 percent of the total INL radiological air emissions in 2009 (Figure 3.6-4). Most of the radiological air emissions at NRF originate from activities at the ECF. The primary activities in ECF are associated with handling and examination of naval spent nuclear fuel and irradiated test specimens. Primary sources of radiological air emissions from ECF include unloading naval spent nuclear fuel from shipping containers, loading naval spent nuclear fuel canisters for temporary dry storage, water pools where fuel is processed and stored, and shielded cells where test specimen and fuel exams are performed. Additional sources of radioactive air emissions at NRF are from the three prototype reactors and chemistry laboratories. Although the prototype reactors have been shut down and defueled, routine inspections of the reactor compartments are conducted and ventilation from these facilities is monitored. Contaminated materials and waste are handled in one of the prototype buildings. Chemistry laboratories are also located in a prototype building.

The 2009 emissions from ECF and NRF are presented in Table 3.6-23. The impact of these emissions on public health is described in Section 3.13.

Table 3.6-23: Radiological Air Emissions for ECF and NRF

Radionuclide[2]	Emissions[1]	
	ECF Operational Emissions	NRF Operational Emissions
	Curies	
^{14}C	8.0×10^{-1}	8.0×10^{-1}
^{3}H	2.4×10^{-2}	2.4×10^{-2}
^{129}I	3.8×10^{-5}	3.8×10^{-5}
^{131}I	5.1×10^{-6}	5.1×10^{-6}
^{85}Kr	1.3×10^{-1}	1.3×10^{-1}
^{239}Pu[3]	6.7×10^{-7}	1.8×10^{-6}
^{90}Sr[4]	2.2×10^{-5}	6.5×10^{-5}
Total	**9.4×10^{-1}**	**9.5×10^{-1}**

[1] Emissions from 2009
[2] Radionuclides released in 2009 that are not typical are not included.
[3] Gross alpha activity is modeled as Pu-239.
[4] Gross beta activity is modeled as Sr-90.

3.7 Noise

The ROI for noise generated at INL is 15 meters (50 feet) from U.S. Highway 20, where noise measurements were taken during the peak commuting period to indicate sound levels from traffic. The ROI for noise generated at NRF includes INL and the closest site boundary to NRF (10.5 kilometers (6.5 miles) west-northwest from the center point of NRF), where noise measurements were taken.

INL

Noise is unwanted sound that can be a by-product of activities at the INL. A common measurement used to indicate sound intensity is decibels as measured on an A-weighted scale (dBA). The noise levels at INL are regulated by the Noise Control Act of 1972, Public Law 92-574, 10 C.F.R. Energy, 30 C.F.R. Mining Resources, 40 C.F.R. § 86 Control of Emissions from New and In-Use Highway Vehicles and Engines, 40 C.F.R. § 92 Control of Air Pollution from Locomotives and Locomotive Engines, 40 C.F.R. § 201 Noise Emission Standards for Transportation Equipment, Interstate Rail Carriers, and 40 C.F.R. § 204 Noise Emissions Standards for Construction Equipment.

At INL, personnel are affected by noises dominated primarily by vehicle traffic including buses, private vehicles, delivery trucks, vehicle warning alarms, and construction equipment. Other dominant noises come from railcar shipments and boiler blow-downs. During a normal work week, the majority of the employees at INL are transported to various work areas at INL by a fleet of buses covering approximately 70 routes. Approximately 1200 private vehicles also travel to and from INL daily. There is no airport at INL, and noise from an occasional commercial aircraft crossing INL at high altitudes is indistinguishable from the natural background noise of the site. Rail-transport noises originate from diesel engines, wheel and track contact, and whistle warnings at rail crossings. Normally no more than one train per day, and usually less than one train per week, services INL (NRC 2004). Homeland Security’s occasional explosive tests at INL, detonation of unexploded ordnance, and railcar coupling (connected vehicles that move on a railway) also contribute to the noise at INL.

Noise measurement data obtained from locations within 15 meters (50 feet) of U.S. Highway 20 show traffic noise ranges from 64 to 86 dBA, with buses identified as the primary source, contributing from 71 to 80 dBA (NRC 2011). INL buses operate off-site, but are part of the normal levels of traffic noise in the community. Industrial activities (i.e., shredding) at the CFA produce the highest noise levels measured at 104 dBA. Noise generated at INL is not detectable off-site, since all primary facilities are at least 4.8 kilometers (3 miles) from site boundaries. In addition, previous studies on effects of noise on wildlife indicate that even high intermittent noise levels at INL (more than 100 dBA) would not affect wildlife productivity. (NRC 2004)

NRF

The noise produced at NRF, and the hearing protection required, is managed in accordance with internal safety requirements based on Occupational Safety and Health Administration (OSHA) regulations, with noise limits set by American Conference of Governmental Industrial Hygienists. Site Safety-approved hearing protection is required when noise levels reach and exceed 85 dBA. These areas are posted “CAUTION Hearing Protection Required.” The range of noise levels expected in the area and the allowed exposure times at those levels before entry into the Hearing Conservation Program are also posted. Double hearing protection (ear plugs and earmuffs) is required in areas where the noise level reaches and exceeds 100 dBA. Employees are enrolled in the Hearing Conservation Program when they are exposed to or exceed 85 dBA as a time weighted average for 8 hours a shift in a calendar year.

NRF is an industrial environment, characterized by noise from trucks, automobiles, cranes, railcar coupling, engine-powered equipment, operating transmission lines, steam-generating boilers, and ECF stack exhaust fans. Noise surveys were taken from 2007 through 2010 of both the inside and outside environment at NRF. The measurements at NRF are obtained with a Sound Level Meter. Noise maps are often generated showing the readings to characterize that area. The noise readings ranged from 55 dBA to 122 dBA; some of the louder sources were above 100 dBA which exceed the Threshold Limit Value of 85 dBA as established by the American Conference of Governmental Industrial Hygienists from the combined sources of industrial operations, construction activities, and vehicular traffic and requires workers to wear double hearing protection (ear plugs and earmuffs) in areas where the noise level reaches and exceeds 100 dBA. The maximum reading of 113 dBA for the outside environment at NRF was the result of steam venting during boiler testing outside of the NRF boiler house. Other readings greater than 100 dBA for the outside environment at NRF were 115 dBA resulting from a flash bang (a device used by security force to create blindness and confusion) demonstration at the INL firing range (approximately 24 kilometers (15 miles) from NRF) and 106 dBA from a deep well pump. For the inside environment, 67 readings were taken between 2007 and 2010. The noise readings ranged from 65 dBA to 122 dBA. Thirteen readings for the inside environment at NRF were above 100 dBA. The maximum reading of 122 dBA was the result of steam venting during boiler testing inside the NRF boiler house. The other readings that exceeded 100 dBA were items such as a tire changer, crane secondary brake testing, and the evacuation alarm. The noise at NRF is not transmitted at detectable levels off-site since the closest site boundary is 10.5 kilometers (6.5 miles) west-northwest from the center point of NRF, and the closest possible member of the public (a residence that is occupied year-round) is located 13.7 kilometers (8.5 miles) from NRF (DOE 2011e).

3.8 Cultural and Historic Resources

This section describes ethnographical resources, paleontological resources, and cultural resources for the ROI (INL and NRF).

3.8.1 Ethnographical Resources

Ethnography is a component of cultural anthropology and involves the study of human cultural systems or ways of life, and how those systems relate to subsistence, resource use, and technology. Ethnographic resources are cultural and natural features (including structures, objects, sites, landscapes, flora, and fauna) that have traditional significance to contemporary people and communities. The Shoshone-Bannock Tribes have a long and traditional association with the area of the proposed action, as detailed in the following sections.

Early Native American Cultures

Although no Native American cultural resources have been specifically identified within the 850-acre survey area that encompasses the three alternatives under consideration for the proposed action, representatives from the Shoshone-Bannock Tribes Heritage Tribal Office (HeTO) indicated that prehistoric archaeological sites, native plants and animals, water, and other natural landscape features across the INL area continue to fill important roles in tribal heritage and ongoing cultural traditions. (Appendix B)

Prehistoric sites are located throughout INL, and demonstrate the importance of the area for aboriginal subsistence and survival. The ethnographic studies completed by early anthropologists describe the seasonal migration of the Shoshone-Bannock people across the ESRP. The area now occupied by INL served as a travel corridor for these groups. The Big Lost River, Big Southern Butte, and Howe Point served as temporary camp areas providing fresh water, food, and obsidian (volcanic glass) for tool making and trade. The Shoshone-Bannock people relied on the environment for all subsistence needs and depended on a variety of plants and animals for food, medicines, clothing, tools, and building materials. (NRC 2004)

The importance of plants, animals, water, air, and land resources in the ESRP to the Shoshone-Bannock people is reflected in the sacred reverence in which they hold the resources. Specific places in the ESRP have sacred and traditional importance to the Shoshone-Bannock people, including buttes, caves, and other natural landforms on or near INL. (NRC 2004)

Native American and Euro-American Interactions

The influence of Euro-American culture and loss of aboriginal territory and reservation land severely impacted the aboriginal subsistence cultures of the Shoshone-Bannock people. Settlers began establishing homesteads in the valleys of southeastern Idaho in the 1860s, increasing the conflicts with aboriginal people and providing the motivation for treaty-making by the federal government. The Fort Bridger Treaty of 1868 and associated EOs designated the Fort Hall Reservation for mixed bands of Shoshone-Bannock people. A separate reservation established for the Lemhi Shoshone was closed in 1907, and the Native Americans were forced to migrate to the Fort Hall Reservation across the area now occupied by INL.

The original Fort Hall Reservation, consisting of 729,000 hectares (1.8 million acres), has been reduced to about 220,000 hectares (544,000 acres) through a series of cessions to accommodate the Union Pacific Railroad and the growing city of Pocatello. Other developments, including the flooding of portions of the Snake River bottoms by the construction of the American Falls Reservoir, have also reduced the Shoshone-Bannock land base.

The creation of INL had an impact on the Shoshone-Bannock subsistence culture. Land withdrawals initiated by the U.S. Navy during World War II and continued by the Atomic Energy Commission during the Cold War restricted access to all lands to authorized personnel. In addition, initial construction of INL facilities may have impacted cultural resources of importance to the Tribes, including traditional and sacred areas and artifacts. (NRC 2004)

Contemporary Cultural Practices and Resource Management

The efforts of the Shoshone-Bannock Tribes to maintain and revitalize their traditional cultures are dependent on having continual access to aboriginal lands, including some areas on INL. DOE accommodates Tribal member access to areas on INL for subsistence and religious uses. Also, Tribal members continue to hunt big game, gather plant materials, and practice religious ceremonies in traditional areas that are accessible on public lands adjacent to INL. The historical record described in the INL Cultural Resources Management Plan supports the conclusion that INL is located within a large original territory of the Shoshone-Bannock people and archaeological and other cultural resources that reflect the importance of the area to the Tribes are located there. DOE recognizes the unique interest the Shoshone-Bannock Tribes have in the management of INL resources and continues to consult with the Tribes.

The maintenance of pristine environmental conditions, including native plant communities and habitats, natural topography, and undisturbed vistas, is critical to continued viability of the Shoshone-Bannock culture. Contamination from past and ongoing operations at INL has the potential to affect plants, animals, and other resources that tribal members continue to use and deem significant. (NRC 2004)

3.8.2 Paleontological Resources

Paleontological resources are fossils of plants or animals from a former geologic age used to investigate prehistoric biology and ecology of the ESRP. Survey and evaluation for paleontological remains within INL boundaries have identified several fossils that suggest that the region contains varied paleontological resources. Analyses of these materials and site locations suggest that these types of resources are found in areas of basalt flows, particularly in sedimentary interbeds or lava tubes within local lava flows, and in some wind and sand deposits. Other and more specific areas in which these resources are likely to occur are in the deposits of the Big Lost River, Little Lost River, Birch Creek, and Lake Terreton and playas. Vertebrate and invertebrate animal, pollen, and plant fossils have been discovered in caves, in lake sediments, and in alluvial gravels along the Big Lost River. Twenty-four paleontological localities have been identified in published data. Vertebrate fossils include mammoth and camel remains, and a horse fossil identified in a borrow source near the CFA (NRC 2004). Paleontological resources are not governed by the same set of laws that apply to cultural resources but are managed in the same way under INL Cultural Resources Management Plan (CRMP) (INL 2009).

3.8.3 Cultural Resources

The area surrounding INL is rich in cultural resources including prehistoric and early historic archaeological artifacts left by indigenous people who inhabited the ESRP, as well as artifacts left by early pioneers who also frequented the area. Cultural resources are defined and protected by a series of federal laws, regulations, and guidelines. Cultural resource categories include prehistoric, historic, and Native American resources. Prehistoric resources are the physical remains of human activities that predate written records. They generally consist of artifacts that alone or collectively can yield information about the past. Historic resources consist of physical remains that post-date the emergence of written records. Native American cultural resources, including small archaeological sites and ecological resources, are important to Native Americans for religious or heritage reasons. Such resources may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features.

INL

To date, numerous cultural resource surveys have been conducted at INL. These surveys have identified many archaeological and historic sites within INL boundaries. Historic uses of the area include attempts at homesteading, cattle drives, as well as a route for settlers traveling west. The most recent use of the area has facilitated the nuclear technology age with research and development of nuclear power. The information from archaeological surveys has provided baseline data used to develop a predictive model that aids in the identification of areas where densities of sites are highest and also where the potential impacts to significant archaeological resources would increase. Although this model does not replace inventories specified by the compliance requirements, this predictive model is crucial to the identification and early mitigation of areas highly likely to be archaeologically sensitive.

Archaeological surveys and investigations conducted in southeastern Idaho have provided evidence of human use of the ESRP for at least 12,000 years. Investigations at a cave about 3.2 kilometers (2 miles) from the INL boundary provided evidence of the earliest human occupation, which was radiocarbon-dated at 12,500 years before present. (NRC 2004)

The southeastern portion of Idaho is also rich with cultural resources that reflect the settlement and development of the region by Euro-American explorers and settlers. As the westward expansion entered the region, resources were left behind that provide a record of historic uses and development of the area. Many of these cultural resources exist within INL boundaries. The region is etched with historic trails used by settlers who attempted to homestead the area. Many of these trails were also used for cattle drives and, in the late 1800s, as stage and freight routes, to support mining towns in central Idaho. Homesteaders attempted to settle and farm the area along the Big Lost River in the late 1800s and early 1900s, but irrigation efforts in the high desert climate failed. Homesteads were abandoned, and Euro-American settlement and development of the region ceased. (NRC 2004)

At the start of World War II, terrain of the desert region proved to be useful to the federal government. The military used different areas, such as the CFA, as test-firing and bombing ranges. The most significant development of the area occurred in 1949, when the National Reactor Testing Station, later to become INL, was established by the government. INL was instrumental in the development of nuclear power, with more than 50 first-of-a-kind reactors constructed since 1949. Many historic sites within INL document early development of nuclear power, including Experimental Breeder Reactor (EBR)-1, which is the only INL resource listed on the National Register of Historic Places (NRHP 2011) and is a national historic landmark. (NRC 2004)

Antiquities legislation, which is legislation to protect relics and monuments from ancient times, requires that no significant cultural resources be adversely affected by construction-related ground-disturbing activities in the area. Antiquities legislation applies at both the federal and state levels. Because of research potential, cultural resource sites are to be left undisturbed. If project plans cannot be altered to avoid damage to these potentially significant sites, the unavoidable adverse impact must be mitigated by further data collection in advance of any ground disturbance.

Consistent with antiquities legislation, the INL CRMP requires that, prior to the start of any ground-disturbing projects, the cultural resources in that area be investigated and identified. Although NRF administrative boundaries are excluded from management under the INL CRMP, NRF follows these guidelines as a best management practice. Several types of cultural resource data collection methods can be used to investigate and identify resources: (1) cultural resources archive searches, (2) archaeological reconnaissance-level surveys in previously examined areas, and (3) intensive archaeological surveys in areas that have never been inventoried. (INL 2011b)

NRF

NRF falls into a "very low" cultural resource probability zone.

Many archaeological surveys have been completed of lands surrounding the fenced perimeter of the NRF since 1985 (Figure 3.8-1). These surveys have resulted in documentation of isolated historic and prehistoric artifact locations, significant prehistoric sites, a significant homestead from the historic period, a significant historic campsite, and small prehistoric campsites. These significant sites are potentially eligible for nomination to the NRHP since they are likely to yield additional information of importance in understanding local prehistory and history. Appendix D includes a summary of cultural resource investigations conducted at NRF.

Surveys that have taken place in the vicinity of NRF have confirmed the archaeological sensitivity of certain areas, especially near the old river channels that cross through this portion of the Big Lost River floodplain. Nearly all of the significant sites from each survey are consistently found along the banks of these channels or along canals that connect to them. The attraction of these channels to prehistoric and early historic populations alike may have been due to the presence of water and water-related resources. (INL 2011b)

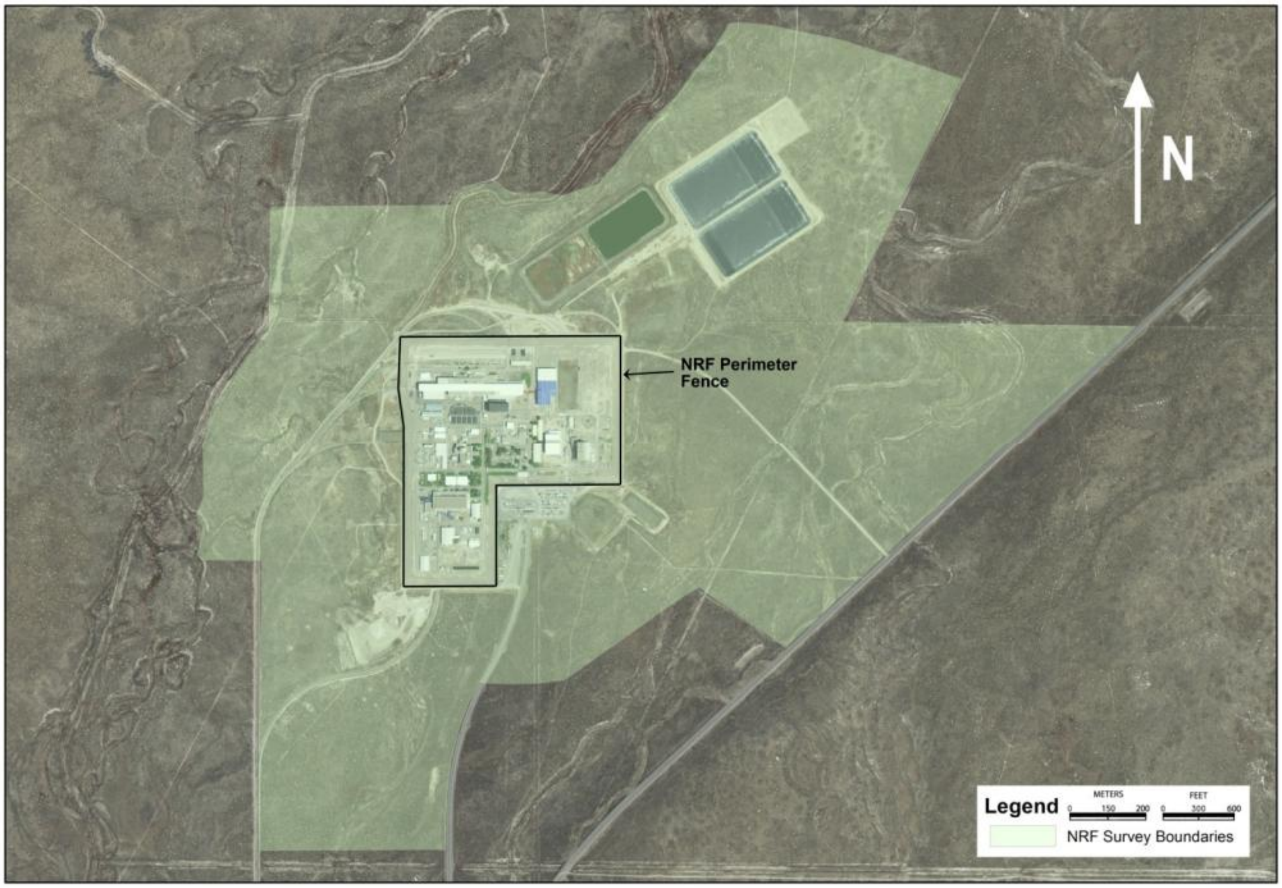


Figure 3.8-1: Cultural Resource Survey Area at NRF

3.9 Visual and Scenic Resources

Visual and scenic resources are the natural (e.g., landforms, water bodies, and vegetation) and manmade (e.g., buildings, fences, and signs) features that give a particular landscape its character and aesthetic quality. The ROI for visual and scenic resources includes INL; the ESRP; Fort Hall Reservation; the Bitterroot, Lemhi, and Lost River mountain ranges; the Big Southern Butte; East Butte; Middle Butte; Circular Butte; and Antelope Butte. INL is situated on the northwestern edge of the ESRP. Volcanic cones, domes, and mountain ranges are visible from most areas on INL. Most of the information used in this section can be found in NRC 2004. Features of the natural landscape have a special importance to the Shoshone-Bannock Tribes, and some prominent features of INL landscape are within the visual range of the Fort Hall Reservation. The Bitterroot, Lemhi, and Lost River mountain ranges are visible to the north and west of INL. The Big Southern Butte, East Butte, and Middle Butte can be seen near the southern boundary, while Circular and Antelope Buttes are visible to the northeast. Smaller volcanic buttes dot the natural landscape of INL, providing a striking contrast to the relatively flat ground surface. In general, the viewscape consists of terrain dominated by sagebrush with an understory of grasses. Juniper is common near the buttes and foothills of the Lemhi range, while crested wheatgrass is scattered throughout INL.

Eight primary facility areas, which resemble commercial or industrial complexes, are located on INL. The facility areas on INL are generally of low density, look like commercial or industrial complexes, and are spread across the site. Structures generally range in height from 3 to 30 meters (10 to 100 feet), with a few emission stacks and towers that reach 76 meters (250 feet). Although many INL facilities are visible from public highways, most are located more than 0.8 kilometers (0.5 miles) from public roads.

Lands within and adjacent to INL follow the BLM Visual Resource Management (VRM) Guidelines. The BLM's VRM system is officially applicable only to BLM land, but it provides a useful tool for inventorying and managing visual resources. This system relies on two main components: visual resource inventories and visual resource management (NRC 2011). Visual resource inventories attempt to establish the visual qualities of an area, assess whether the public has any concerns related to scenic quality for a location, and determine if there is sensitivity of the location for visual intrusions. Sensitivity is based on the types of users that would view the location (e.g., recreational users, commuters, or workers), the amount of use, public interest, and adjacent land uses. There are four levels of VRM rating, designated as VRM Classes I to IV, with Class I being the most restrictive and protective of the visual landscape and Class IV being the least restrictive.

BLM VRM Guidelines (NRC 2004):

- Class I - Preserve the existing character of the landscape. This class provides for natural ecological changes and does not preclude limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
- Class II - Retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- Class III - Partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

- Class IV - Provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. Every attempt should be made, however, to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Lands adjacent to INL are designated as a visual resource Class II area, which allows for moderate industrial growth, preserving and retaining the existing character of the landscape. Lands within the boundaries of INL are designated as Class III and Class IV areas, allowing for partial retention of existing character and major modifications, respectively.

Craters of the Moon National Monument is located southwest of INL; a wilderness area is located within the boundary of the monument. The wilderness area must maintain Class I visual resource management objectives. Yellowstone National Park and Grand Teton National Park are located east of INL and are also considered Class I areas. The BLM is considering the Black Canyon Wilderness Study Area, located adjacent to INL, for wilderness designation, which, if approved, would result in an upgrade of the BLM Visual Resource Management class for the area from Class II to Class I.

The BLM Visual Resource Management Classes should not be confused with the PSD area classification in Section 3.6.2.1, which also uses Class I, II, and III designations.

Emissions screening for INL facilities for SO_x, H_2SO_4, NO_x, and PM_{10}, and the threshold for visibility and deposition analyses are discussed in Section 3.6.3.4.

3.10 Socioeconomics

This section describes current socioeconomic conditions and local community services within the seven-county ROI associated with INL: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison counties. Also included are the Fort Hall Reservation and the Trust Lands, home of the Shoshone-Bannock Tribes, which lie largely within Bingham and Bannock counties. Figure 3.10-1 shows the counties in the ROI as well as towns and major transportation routes.

INL is a major economic contributor to the southeastern Idaho economy. Approximately 8,000 people are employed at INL, and much of the services and material consumed by INL activities are provided by local businesses. (INL 2010b)

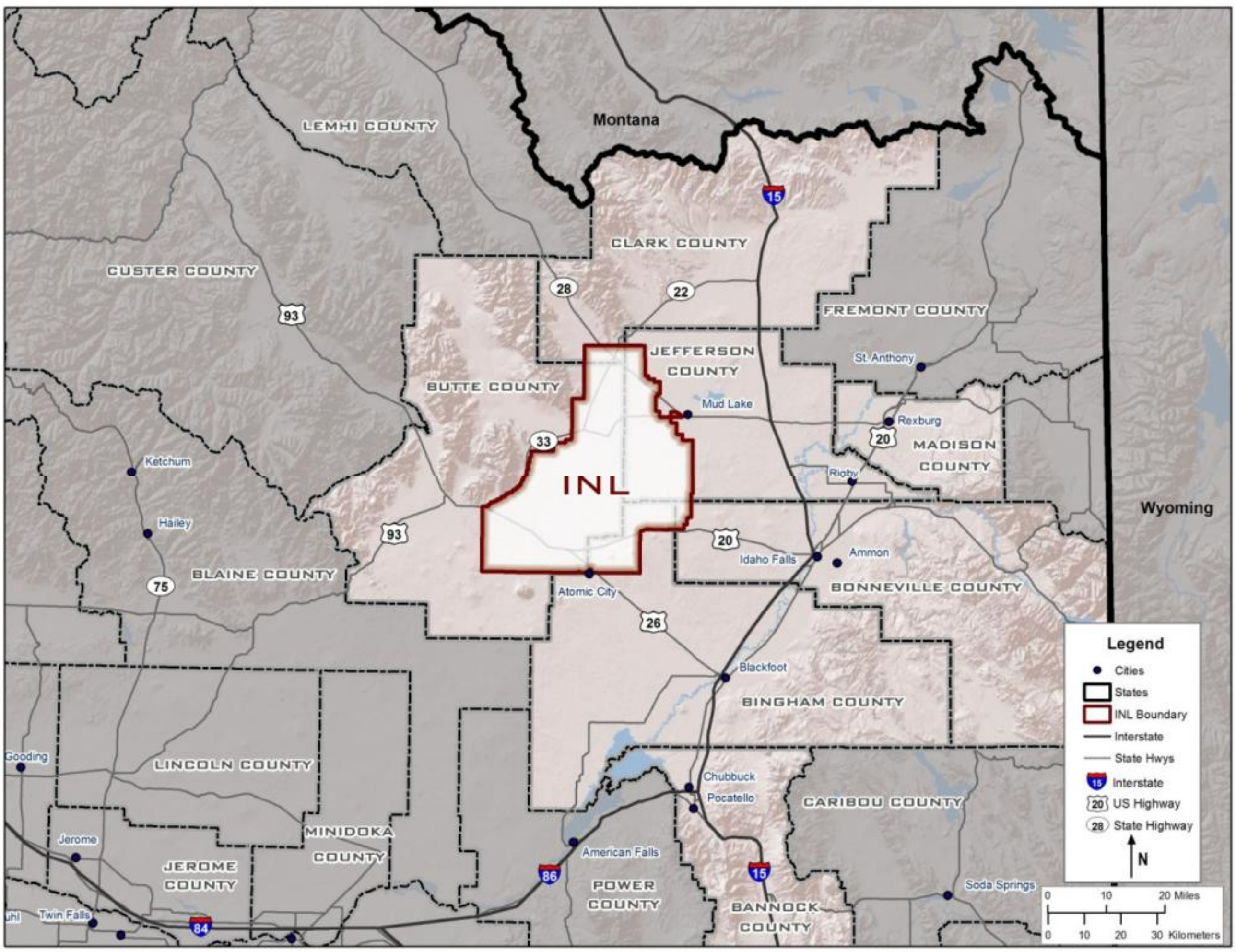


Figure 3.10-1: INL and the Region of Influence for Socioeconomics

3.10.1 Population and Housing

Population

The main population surrounding INL lies to the east, along Interstate Highway I-15 and State Highway 91, which generally run north and south. The two largest cities (Pocatello and Idaho Falls) are approximately 80 air kilometers (50 air miles) from NRF. Most of the population is concentrated in communities to the southeast: Pocatello with a population of approximately 54,000, Idaho Falls with a population of approximately 56,000; and Blackfoot with a population of approximately 12,000 (USCB 2012a). The entire area within an 80.5-kilometer (50-mile) radius of NRF contains a population of approximately 159,000.

Population growth in the ROI paralleled statewide growth from 1960 to 1990, with approximate average annual rates of 1.3 and 1.4 percent, respectively (DOE 2002c). However, from 1990 to 2010, state population growth accelerated to 2.9 percent a year, compared with a ROI growth of 1.4 percent (DOE 2002c). From 2000 to 2010, State population growth increased by 21.2 percent, compared to the ROI population growth of 20.7 percent or an average of 2.1 percent per year for both the ROI and the State (USCB 2012a). Table 3.10-1 contains population estimates created by the U.S. Census Bureau for 2005 and actual census results for 1990, 2000, and 2010. U.S. Census Bureau estimates are not certain due to variability in times of birth and death, emigration and immigration rates, and other unanticipated factors in the region.

Table 3.10-1: Population of INL Region of Influence and Idaho: 1990-2010

County	Year			
	1990	**2000**	**2005**	**2010**
Bannock	66,026	75,565	78,604	82,839
Bingham	37,583	41,735	42,909	45,607
Bonneville	72,207	82,522	90,666	104,234
Butte	2918	2899	2781	2891
Clark	762	1022	914	982
Jefferson	16,543	19,155	21,189	26,140
Madison	23,674	27,467	35,173	37,536
ROI	219,713	250,365	272,236	300,229
Idaho	1,006,749	1,293,953	1,425,862	1,567,652

The population density within an 80.5-kilometer (50-mile) radius around NRF is represented in Figure 3.10-2. Figure 3.10-3 shows the 2010 population distribution within the ROI.

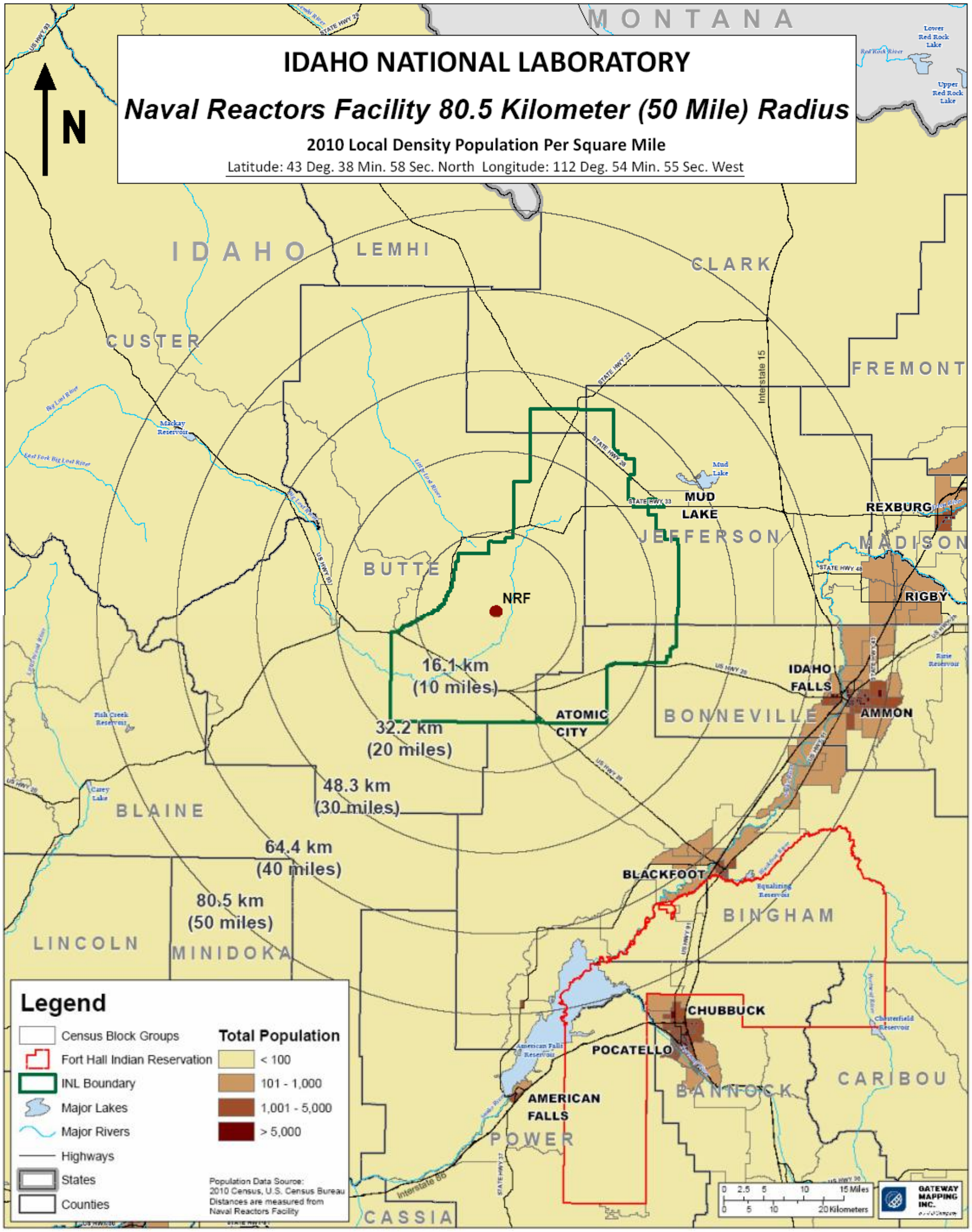


Figure 3.10-2: Population Density Within the 80.5-Kilometer (50-Mile) Radius Surrounding NRF

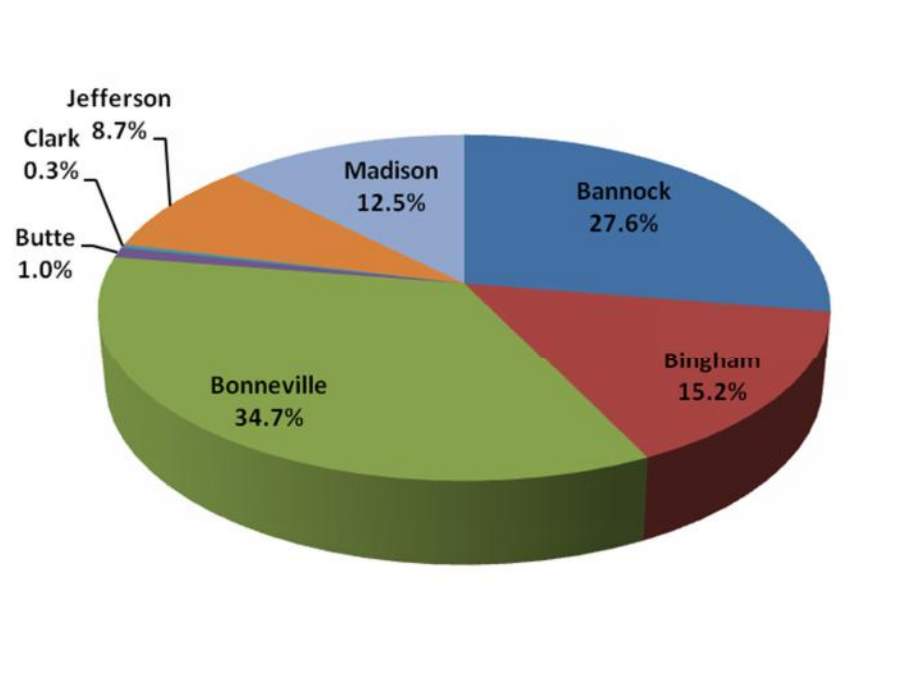


Figure 3.10-3: 2010 Population Distribution Within the ROI

Housing

Of the 110,950 housing units available in the ROI during 2010, the Renter Vacancy Rate was 7.7 percent, and the Homeowner Vacancy Rate was 2.2 percent. The average Renter Vacancy Rate for the state of Idaho was 8.5 percent, and the average Homeowner Vacancy Rate for the State was 3.1 percent. Rental units made up 30 percent of the occupied housing units in the ROI. This number compares with 30 percent for the State as a whole. There are a total of 8400 vacant units in the ROI (USCB 2012b). Housing characteristics for the ROI in 2010 are shown in Table 3.10-2.

Table 3.10-2: ROI 2010 Housing Characteristics

County	Occupied Housing Units	Owner-Occupied Units	Owned-Housing Vacancy Rates	Number of Renter-Occupied Units	Rental Vacancy Rates
			percent		percent
Bannock	30,682	20,817	2.3	9865	8.0
Bingham	14,999	11,563	1.5	3436	7.8
Bonneville	36,629	26,336	2.6	10,293	9.4
Butte	1129	865	2.1	264	13.2
Clark	345	217	2.2	128	9.9
Jefferson	8146	6774	1.9	1372	6.2
Madison	10,611	5119	1.7	5492	3.8
ROI	102,541	71,691	2.2	30,850	7.7
Idaho	579,408	404,903	3.1	174,505	8.5
Source: USCB 2012b					

3.10.2 Employment and Income

Employment

From 2000 to 2010, the ROI experienced an average annual growth rate in the labor force of just under 10 percent (from 131,352 to 143,844), while the state of Idaho's labor force grew at an average annual rate of 13 percent (from 662,958 to 749,660). Employment in the ROI grew at an average annual rate of about 7 percent, compared to the State rate of 9 percent. Table 3.10-3, Table 3.10-4, and Table 3.10-5 depict historical trends in labor force, employment, and unemployment, respectively. The ROI experienced the lowest unemployment rate (3.4 percent) in 2005 when the unemployment rate ranged from 2.5 percent in Madison County to 4.6 percent in Clark County. (BLS 2010)

INL influences the regional economy. In FY 2010, INL accounted for approximately 8000 jobs or about 3.5 percent of the total workforce in the State and over 9 percent of employment in eastern Idaho (INL 2010b). INL is among the top five employers in the State (the state government is the largest) and is the largest in southeast Idaho. Micron Technology, Wal-Mart and Associates, and New Albertsons, Inc. are also major employers in the region (INL 2006). Figure 3.10-4 shows the distribution where INL employees live in the ROI.

Table 3.10-3: Historical Trends in ROI Labor Force

County	Year				
	1990	**1995**	**2000**	**2005**	**2010**
Bannock	31,342	36,310	39,502	40,027	40,137
Bingham	18,383	20,507	21,908	20,781	22,651
Bonneville	38,632	43,422	46,479	48,411	50,525
Butte	1447	1542	1596	1379	1534
Clark	549	623	577	539	558
Jefferson	8078	9158	10,269	10,631	11,376
Madison	7406	9695	11,021	14,802	17,063
ROI	105,837	121,257	131,352	136,570	143,844
Idaho	494,121	598,984	662,958	722,190	749,660
Sources: BLS 1997, BLS 2010					

Table 3.10-4: Historical Trends in ROI Employment

County	Year				
	1990	**1995**	**2000**	**2005**	**2010**
Bannock	29,051	34,183	37,533	38,603	37,138
Bingham	17,320	19,363	20,896	20,068	21,370
Bonneville	37,127	41,563	44,921	47,070	47,487
Butte	1381	1479	1537	1324	1447
Clark	533	596	549	514	535
Jefferson	7633	8685	9873	10,308	10,654
Madison	7029	9373	10,479	14,430	16,031
ROI	100,074	115,242	125,788	132,317	134,662
Idaho	467,102	567,558	632,451	695,428	689,556
Sources: BLS 1997, BLS 2010					

Table 3.10-5: Historical Trends in ROI Unemployment Rates

County	Year				
	1990	1995	2000	2005	2010
	percent				
Bannock	7.3	5.9	5.0	3.6	8.3
Bingham	5.8	5.6	4.6	3.4	7.6
Bonneville	3.9	4.3	3.4	2.8	7.2
Butte	4.6	4.1	3.7	4.0	6.9
Clark	2.9	4.3	4.9	4.6	10.6
Jefferson	5.5	5.2	3.9	3.0	7.6
Madison	5.1	3.3	2.5	2.5	6.5
ROI	5.0	4.7	4.0	3.4	7.8
Idaho	5.5	5.2	4.6	3.7	8.7
Sources: BLS 1997, BLS 2010					

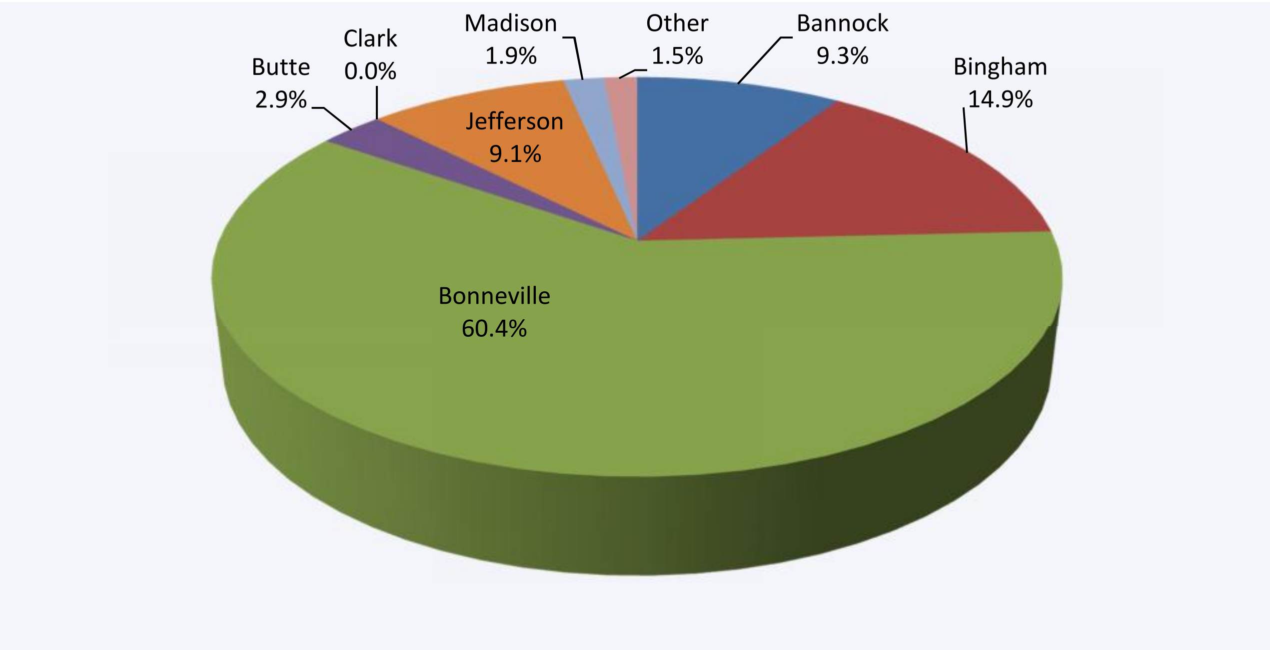


Figure 3.10-4: INL Employee Distribution Within the ROI Counties

NRF Employment

Approximately 1370 employees work at NRF including government employees, subcontractors, contractors, service employees, part-time seasonal, temporary, and occasional workers. Of these employees, 610 work in ECF and are split between examination work (approximately 160 employees) and spent fuel handling work (approximately 450 employees). Approximately 550 employees at NRF are employed doing site-related work.

In the 1980's, NRF experienced the historical peak in personnel on-site. NRF employed an approximate average of 1070 employees annually. With the addition of the U. S. Navy students and staff, there were approximately 2600 people working at NRF during this timeframe.

Local Income

In 2009, wages and salaries paid to INL employees totaled $419.2 million in Bonneville County, which is 30.6 percent of all wages earned in the county. INL wages and salaries exceed $50 million annually in each of Bannock, Bingham, and Jefferson Counties, and more than $10 million annually in each of Butte and Madison Counties. The average INL employee earns more than $80,000 annually in gross income (INL 2010b). In comparison, the average median household income for the ROI is about $44,000 and about $46,000 annually for the state of Idaho (USCB 2012a). In 2009, annual personal income for the state of Idaho was estimated to be $52 billion. INL accounted for 3.5 percent ($1.83 billion) of the total personal income for the State (INL 2010b).

3.10.3 Community Services

Key community services in the ROI include education, law enforcement, fire protection, and medical services. Public school districts (21) and private schools (13) serve 58,819 school children in the ROI (NCES 2009). Idaho State University, University of Idaho Center of Higher Education, Brigham Young University-Idaho, and the Eastern Idaho Technical College are institutions of higher education within the ROI. The seven-county ROI has 189 sworn police officers and 114 civilians to provide law enforcement. Idaho Falls and Pocatello have 89 and 88 sworn police officers, respectively. Police departments range in size from those in Idaho Falls that employ 89 police officers to those in Clark County with three police officers (FBI 2009).

The Idaho Falls Fire Department serves an Emergency Fire Service population of approximately 75,000 residents occupying approximately 1036 square kilometers (400 square miles). The area includes the city of Idaho Falls and the Bonneville County Fire Protection District. The Idaho Falls Fire Department currently employs 84 firefighters and has a Hazardous Materials Team that requires special training (IFFD 2011). In addition, the INL Fire Department provides 24-hour coverage for the site. Its staff includes 50 firefighters, with no less than 16 on each shift. Bonneville, Butte, Clark, and Jefferson Counties, which surround INL, have developed emergency plans to be implemented in event of a radiological or hazardous materials emergency. Each emergency plan identifies facilities, including those on INL, that have the most hazardous substances and defines routes for transportation of these substances. The emergency plans also include procedures for notification and response, listings of emergency equipment and facilities, evacuation routes, and training programs.

There are 58 hospital-based practices in the ROI. Approximately 84 percent of these are in Bannock and Bonneville Counties. Although 490 physicians practice in the region, no primary-care physicians are located in Clark County. (AMA 2010)

3.10.4 Public Finance

INL employees' tax support to the state of Idaho is presented in Table 3.10-6. The column labeled "Direct" represents taxes paid directly by INL employees. The column labeled "Secondary" represents the secondary taxes paid by residents and businesses in the area; INL employees spend their income on goods and services provided by residents and businesses in the area surrounding INL. These taxes help fund public schools, libraries, emergency services (ambulance, police, and fire protection), road and bridge repairs, recreational opportunities, and waste disposal. Total taxes and fees attributed to INL and its employees amounted to more than $135 million of Idaho's total tax receipts in 2009. This represented 5.7 percent of Idaho's FY 2009 total general fund revenues. (INL 2010b)

Table 3.10-6: Fiscal Impacts of INL - Taxes Paid to the State of Idaho in 2009

Type of Tax	Direct	Secondary	Total
	millions of dollars		
Personal Income	40.8	13	53.8
Corporate Income	5.4	1.7	7.1
Idaho Sales	37.2	11.8	49.0
Sales and Franchise Taxes Paid by INL	8.3	0.0	8.3
Vehicle License Fees and Motor Fuels	10.5	3.4	13.9
Other Idaho Products (Beer, Wine, Alcohol, & Cigarette)	2.4	0.7	3.1
Total Idaho Tax Impact	**104.6**	**30.6**	**135.2**
Source: INL 2010b			

3.11 Energy Consumption and Site Utilities

This section describes energy consumption and site utilities for the ROI (INL and NRF).

INL

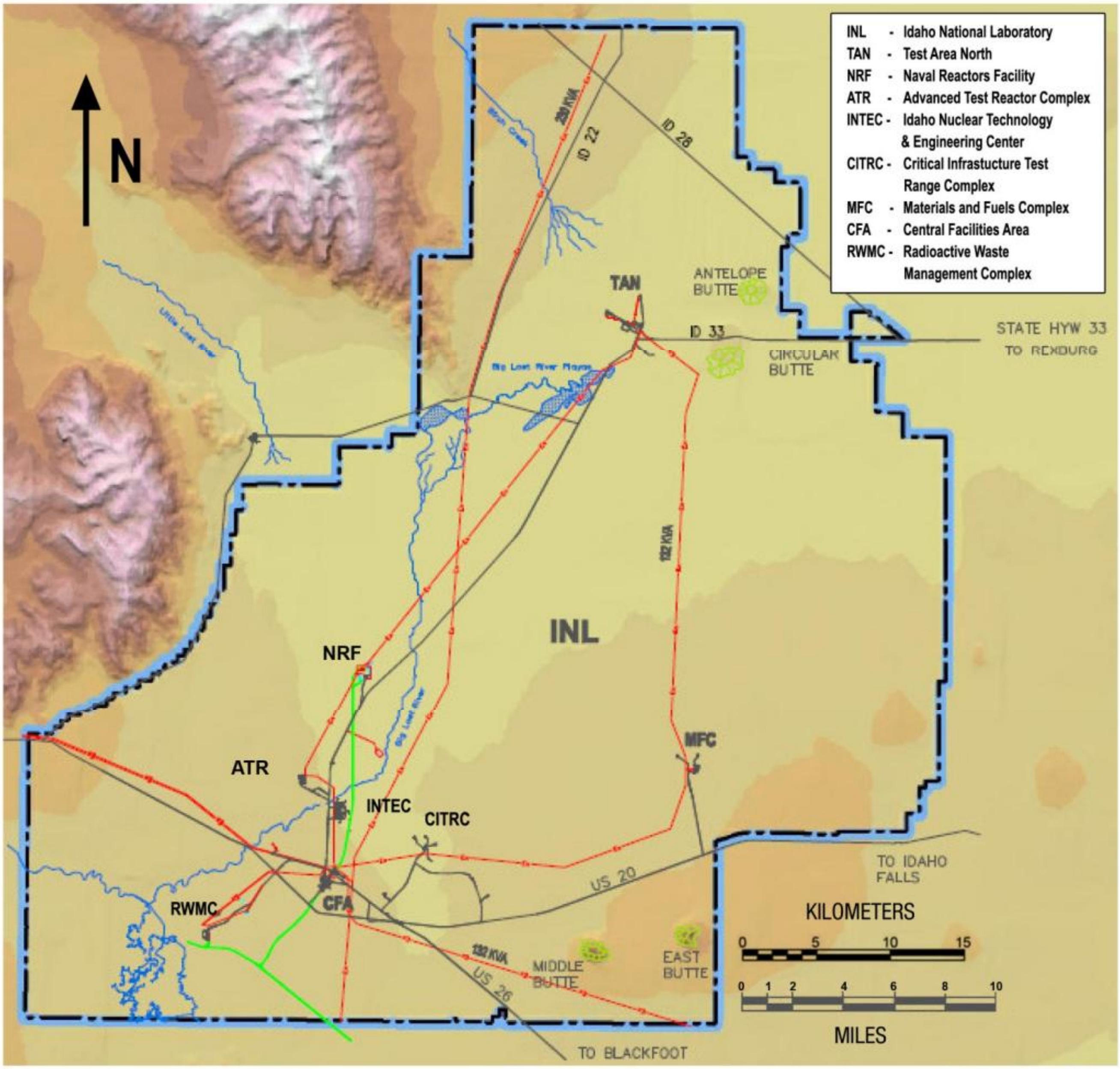
Characteristics of INL's facility and utility infrastructure are described below.

Figure 3.11-1 shows the overall INL infrastructure including the electrical distribution and facility locations. Figure 3.11-1 also shows the road and rail network on INL. Section 3.2 provides additional details of the transportation infrastructure on INL.

Buildings and structures are clustered within the eight facility areas at INL described in Section 3.1. These areas are typically less than a few square kilometers (several hundred acres) in size, separated by kilometers (miles) of open land. The CFA provides support services (e.g., medical, fire suppression, transportation, security, communications, electrical power, craft support, warehousing, and instrument calibration) (INL 2010c). NRF uses CFA medical emergency, fire suppression, and transportation services.

DOE presently contracts with the Idaho Power Company to supply electric power to INL using a combination of sources: approximately 52 percent hydroelectric, 32.5 percent thermal (coal-fired), 8.6 percent wind, 5.0 percent natural gas, 0.6 percent biomass, 0.6 percent geothermal, and 0.7 percent from other sources (Idaho 2012). The percentages vary annually based on water availability for hydroelectric use. For example, in years with high spring snow melt, the percentage of hydroelectric power use may increase over coal and other purchases.

Idaho Power transmits power to INL via a 230-kilovolt line to the Antelope substation, owned by PacifiCorp (Utah Power Company). PacifiCorp has transmission lines to this substation, which provides backup in case of problems with the Idaho Power system. At the Antelope substation, the voltage is dropped to 138 kilovolts, and then transmitted to the DOE-owned Scoville substation via two redundant feeders. The INL transmission system is a 138-kilovolt, 105-kilometer (65-mile) loop configuration (Figure 3.11-1) that encompasses seven substations, where the power is reduced to distribution voltages for use at the various INL facilities. The loop allows for a redundant power feed to these substations and facilities (DOE 2002c). INL electrical energy availability is about 394,000 megawatt-hours per year, based on the contract demand in the agreement with Idaho Power and DOE of 45,000 kilowatts (45 megawatts) for 8760 hours per year. The maximum contract demand has a ceiling of 55 megawatts; however, DOE has the ability under the agreement with Idaho Power to ask for additional demand above the 55 megawatt ceiling, which may be granted at Idaho Power's discretion. Current electrical energy consumption at INL is 209,250 megawatt-hours annually. The peak electrical demand at INL is about 30 megawatts.



Note: The electrical distribution is designated by red lines, roads by black lines, and rail by green lines.

Figure 3.11-1: INL Infrastructure

Fuel oil use at INL in 2009 was approximately 7,244,000 liters per year (1,914,000 gallons per year). There is no site capacity for fuel oil at INL; it is only limited by the ability to ship resources to the site.

The SRPA is the source of all water used at INL. The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right for INL of 43 billion liters (11.4 billion gallons) per year for the site (DOE 2002c). In 2009, INL's production well system (including NRF) withdrew a total of about 3.6 billion liters (949 million gallons) of water which is slightly below the historical average (Section 3.4.2.4). This water use represents approximately 8 percent of the Federal Reserved Water Right for INL.

NRF

Electrical power to NRF is supplied by Idaho Power through a high-voltage transmission network maintained by the INL prime contractor. Two 138-kilovolt circuits on separate transmission towers enter the NRF facility along the west side of the site and terminate in a substation transformer yard. The peak electrical demand in 2013 was approximately 6 megawatts. Electrical power usage at NRF in FY 2013 was approximately 22,000 megawatt-hours.

NRF uses fuel oil for the three fuel oil-fired boilers. The fuel oil usage at NRF for these fuel oil-fired boilers is approximately 2,280,000 liters (603,000 gallons) annually. NRF uses approximately 42,000 liters per year (11,000 gallons per year) on diesel fuel for emergency diesel generators (and miscellaneous small diesel combustion sources) and 5300 liters per year (1400 gallons per year) of gasoline on miscellaneous combustion sources (e.g., air compressors and heaters). There is also an 1140-liter (300-gallon) propane tank used to light the boilers for startup of the system, and a fill station for transfer of fuel from tanker trucks to storage tanks. The fuel is stored in two above-ground storage tanks, and piping is run from the tanks to the generators. The storage tanks are placed in concrete containment basins. All piping is placed in containment carrier pipes to meet environmental requirements.

The NRF potable water system consists of three deepwells, an electrolytic disinfection system, a softener, and a distribution system. A new well, NRF-14, was put into operation in March 2009. Two of the three deepwells for potable water are currently in use (NRF-3 and NRF-14). The third deepwell (NRF-2) is not currently being used. The site non-potable water system consists of two deepwells (NRF-1 and NRF-4), two above-ground water storage tanks, and the associated water mains connecting the deepwells and tanks. NRF-1 and NRF-4, each with a capacity of 7570 liters per minute (2000 gallons per minute), are the sources of water for the fire protection system, landscaping water, process water, and all other non-potable water needs at NRF. Average annual water use (potable and non-potable) at NRF based on 5 years of data (2005-2009) was approximately 140 million liters (37 million gallons), and ranged from 118 million liters (31 million gallons) to 156 million liters (41 million gallons). The average is about 0.3 percent of the Federal Reserved Water Right for INL (Section 3.4.2.4).

The NRF sanitary sewer system consists of several small lift stations and one main lift station near the southeast corner of the site. The main lift station pumps the sanitary waste to the two active sewage lagoons located northeast of the site. The sewage lagoons are discussed in Section 3.4.1.3.

NRF security infrastructure consists of a perimeter fence that is approximately 2430 linear meters (8000 linear feet) that surrounds the entire NRF complex.

3.12 Environmental Justice

The ROI for environmental justice is the 80.5-kilometer (50-mile) radius of NRF. The 80.5-kilometer (50-mile) radius was selected because it is consistent with the ROI for air emissions and because it includes portions of the seven counties that constitute the ROI for socioeconomics.

EO 12898 directs federal agencies to make the achievement of environmental justice part of their mission. This goal is accomplished by identifying and addressing disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations. Federal agencies indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, and Native Americans. The following discussion is in accordance with the guidelines and procedures for compliance with the EO promulgated by the Council on Environmental Quality (CEQ) (CEQ 1997).

The definitions of minority, minority populations, and low-income populations are presented below (CEQ 1997).

> **Minority** - Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
>
> **Minority population** - Where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.
>
> In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority population.
>
> **Low-income population** - Low-income populations are identified with the annual statistical poverty thresholds from the Bureau of the Census' *Current Population Reports, Series P-60 on Income and Poverty.* If the total income for a family or individual falls below the relevant poverty threshold, the family or individual is classified as being "below the poverty level." In identifying low-income populations, a community may be considered as either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Community Characteristics

In accordance with CEQ guidelines, demographic maps were prepared using the latest available census data from the U.S. Census Bureau. Census tracts are designated areas that encompass from 2500 to 8000 people. Block Numbering Areas follow the same basic criteria as census tracts in counties without formally defined tracts. Figures 3.12-1 and 3.12-2 illustrate census tract distributions for minority and low-income populations within 80.5 kilometers (50 miles) of NRF, respectively.

Demographic information from the U.S. Census Bureau was used to identify minority populations and low-income populations within the ROI (Table 3.12-1).

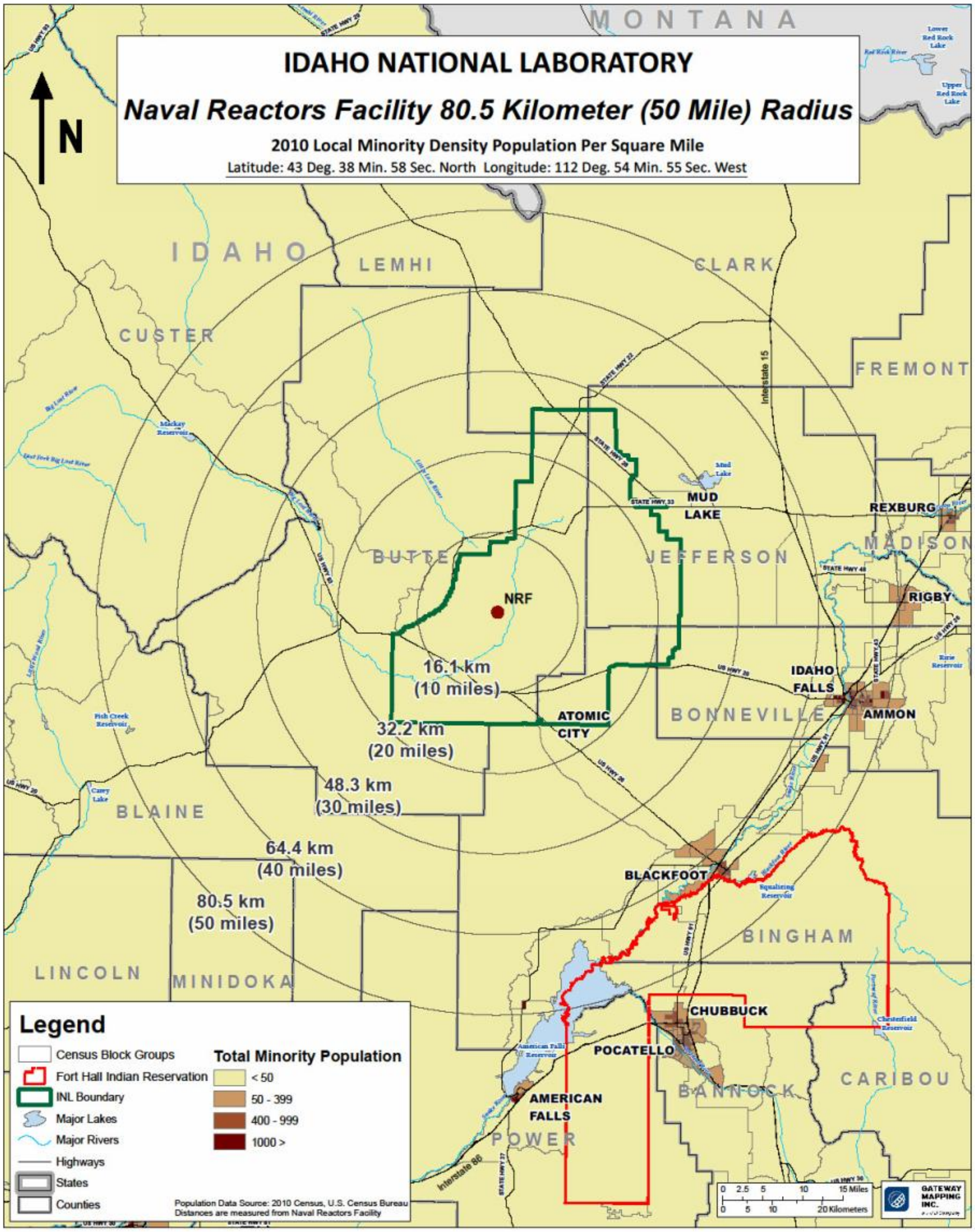


Figure 3.12-1: Minority Population Within the 80.5-Kilometer (50-Mile) Radius of NRF

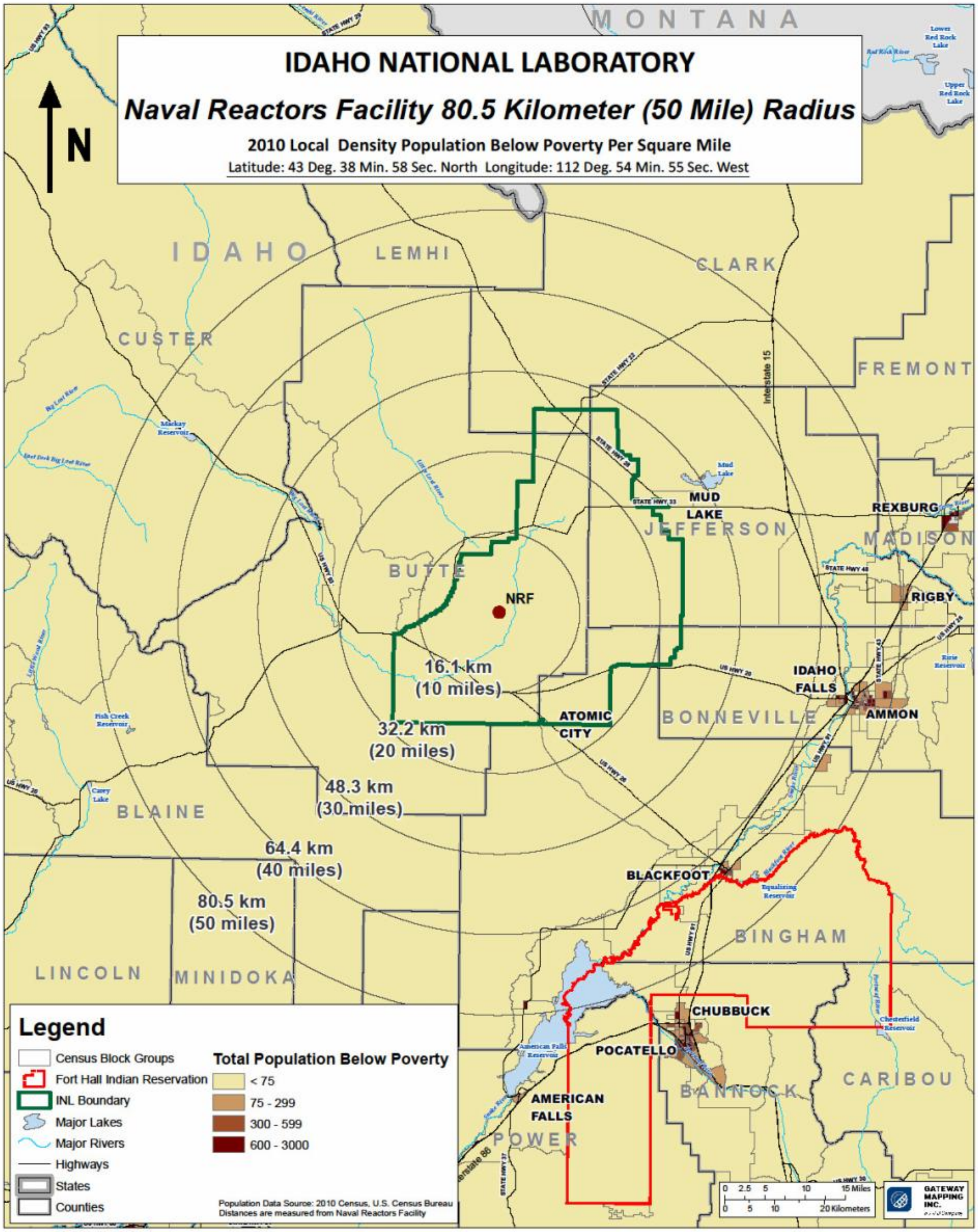


Figure 3.12-2: Low-Income Population Within the 80.5-Kilometer (50-Mile) Radius of NRF

Table 3.12-1: Minority and Low-Income Population Within the 80.5-kilometer (50-mile) Radius of NRF

Environmental Justice Population	Population	Percent
Minority		
Native American	3945	2.5
Hispanic	21,477	13.5
African American	712	0.4
Asian	1147	0.7
Other	1513	1.0
Total Minority	28,794	18.1
Low Income		
Families Below Poverty Line	17,862	11.2
Note: Total population of ROI is approximately 159,000.		

According to 2012 U.S. Census Bureau data for the counties in the ROI, 300,299 people resided in the area. The minority groups constitute 10.7 percent of the population of the ROI (Table 3.12-2). The minority population near INL is predominantly Hispanic, Native American, and Asian. The Fort Hall Reservation of the Shoshone-Bannock Tribes lies largely within the ROI.

Table 3.12-2: 2010 Minority Populations Within the ROI

County	Total Population	Minority Population	County Percent Minority	State Percent Minority	ROI Percent Minority
Bannock	82,839	8438	10.2	10.9	10.7
Bingham	45,607	8855	19.4		
Bonneville	104,304	9893	9.4		
Butte	2891	130	4.5		
Clark	982	271	27.6		
Jefferson	26,140	2296	8.8		
Madison	37,536	2301	6.1		
Total	300,299	32,184			
Source: USCB 2012c					

With regard to low-income population data, Madison County has the highest rate of individuals below the poverty level at 32.2 percent. Approximately 15.0 percent of the total population within the ROI live below the 2010 poverty levels (for individuals) compared to about 13.6 percent for the state of Idaho (Table 3.12-3). The data in Table 3.12-4 indicate wide differences in median household income levels (from a low of approximately $35,500 in Madison County (9868 households) to a high of approximately $51,600 in Jefferson County (7781 households)). The median household income for the state of Idaho in 2010 was approximately $46,400; the average median income for the ROI was approximately $43,800. (USCB 2012c)

Table 3.12-3: 2010 Low-Income Populations

County	Total Population	Low-Income Population	County Percent Low-Income	State Percent Low-Income	ROI Percent Low-Income[1]
Bannock	82,839	11,597	14.0	13.6	15.0
Bingham	45,607	6704	14.7		
Bonneville	104,304	11,473	11.0		
Butte	2891	399	13.8		
Clark	982	111	11.3		
Jefferson	26,140	2666	10.2		
Madison	37,536	12,087	32.2		
Total	300,299	45,038			

Source: USCB 2012c
[1]ROI Percent Low-Income calculated by taking the total of the County Percent Low-Income column and dividing it by the total population of the ROI.

Table 3.12-4: 2010 Median Household Income

County	County Median Household Income	State Median Household Income	Average ROI Median Household Income[1]
Bannock	$44,848	$46,423	$43,826
Bingham	$44,128		
Bonneville	$50,445		
Butte	$39,413		
Clark	$40,909		
Jefferson	$51,579		
Madison	$35,461		

Source: USCB 2012c
[1] Average ROI Median Household Income calculated by taking the total of the County Median Household Income column and dividing it by the number of counties in the ROI.

3.13 Public and Occupational Health and Safety

This section describes the NNPP safety strategy to provide robust protection to the public, workers, and the environment against the effects of ionizing radiation and radioactive contamination resulting from naval spent nuclear fuel work performed at NRF. The NNPP also provides a working environment safe from unnecessary physical hazards and other workplace hazards such as hazardous materials and hazardous energy.

The NNPP strategy is to eliminate hazards whenever practical. This includes eliminating the use of hazardous materials or substituting less hazardous materials whenever possible. When hazards cannot be eliminated, such as hazards involved with handling naval spent nuclear fuel, the NNPP applies stringent designs and controls to ensure robust protection.

For naval spent nuclear fuel handling the NNPP applies principles of defense-in-depth, safety-in-design, and a graded approach to ensure protection of the public, workers, and the environment. These principles are described below. Additionally, the NNPP practice is to first minimize reliance on active safety systems and use passive safety systems as a primary means of protection whenever practicable.

Defense-in-Depth

The principle of defense-in-depth assumes that a single protection from a hazard, no matter how robust, or how well controlled and implemented, may fail, resulting in potential exposure to the hazard. To combat this potential, defense-in-depth considers the application of successive layers of protection such that if any one layer fails, the remaining layers, either individually or in combination, will continue to prevent potential exposure to the hazard.

Safety-in-Design

The principle of safety-in-design requires that safety be considered early in the design process and hazards be identified as early as possible. Use of this principle minimizes costly rework to back-fit safety features into designs while simultaneously increasing designer awareness of safety requirements, issues, and approaches. This principle ensures that safety is engineered into the final design, especially for specialized equipment used to handle naval spent nuclear fuel.

Graded Approach to Safety

A graded approach to safety is implemented using the guidance of DOE 2008a. The principle of the graded approach recognizes that some hazards pose more risk than others; therefore, more effort and resources are dedicated to the prevention and mitigation of higher risk hazards.

Code of Record

As part of the design process, a code of record is established to set the standards that are used for design and construction. After the code of record is set, if technical codes and standards are superseded by new or revised codes and standards, the new requirements documents are reviewed and their impact on project safety, cost, scope, and schedule are considered. Based on the impacts, a determination would be made as to whether the new requirements would be implemented.

3.13.1 Non-Radiological Health and Safety

The ROI for occupational non-radiological health and safety includes INL and NRF, the location of the proposed action. The ROI for public non-radiological health and safety is the 80.5-kilometer (50-mile) radius from INL.

3.13.1.1 Occupational Non-Radiological Health and Safety

Non-radiological occupational exposures at INL and NRF are controlled through the implementation of industrial hygiene and occupational safety programs. The INL and NRF track numerous performance indicators that are consistent with those of general industry using OSHA's occupational injury and illness reporting criteria. The performance indicators are used to describe baseline conditions of occupational health and safety in this section. A Days Away, Restricted or on-the-job Transfer (DART) case is described as an injury or illness case where the most serious outcome of the case resulted in days away from work or days of job restriction or transfer. Total Recordable Cases (TRC) are defined as the total number of work related injuries or illnesses that resulted in death, days away from work, job transfer or restriction, or recordable case as identified in OSHA Form 300.

INL

In 2012, the DART case rate at INL was 0.5. In 2012, the TRC rate for injury and illnesses at INL was 0.9. The incidence rates represent the number of injuries and illnesses per 100 full-time workers. There were no fatalities at INL between 2000 and 2012; therefore, the fatality rate is zero. (CAIRS 2012, 2013)

NRF

For nearly all civilian workplaces, the Occupational Safety and Health Act of 1970 (Act) provides authority to set occupational health and safety standards. The Act excludes activities and facilities, such as NRF, that are regulated under separate authority. Under the Atomic Energy Act of 1954, the DOE was assigned authority to set and enforce occupational health and safety standards for its facilities and activities covered by the Act. Within the DOE, authority to set and enforce these standards at NNPP facilities is assigned to the deputy administrator for Naval Reactors (NNPP), pursuant to 50 U.S.C. § 2406, 2511 which codify EO 12344. These documents establish that the deputy administrator of the NNPP is responsible for all matters pertaining to naval nuclear propulsion. The NNPP establishes and enforces its occupational safety, health and occupational medicine programs which incorporate many requirements put forth by OSHA.

NRF injury data are reported separately from INL. In 2012, the TRC rate for injury and incidences at NRF was 1.0. The DART case rate at NRF was 0.5 in 2012. The incidence rates represent the number of injuries and illnesses per 100 full-time workers. There were no fatalities at NRF between 2000 and 2012; therefore, the fatality rate is zero. (CAIRS 2012, 2013) Furthermore, there has never been a fatality at NRF (NNPP 2011b).

3.13.1.2 Public Non-Radiological Health and Safety

INL

Health risks to the public from routine non-radiological airborne emissions at INL have been previously estimated (DOE 1995). These estimates considered exposures to an INL maximally exposed off-site public individual (MEI) and the population within 80.5 kilometers (50 miles) of the site. With EPA dose response values being used in the calculations, no adverse health impacts for non-carcinogenic constituents in air emissions (including fluorides, ammonia, and hydrochloric, and sulfuric acids) were projected. Off-site excess cancer risk from carcinogenic emissions (e.g., arsenic, benzene, carbon tetrachloride, and formaldehyde) ranged from 1 in 1.4 million to 1 in 625 million. Risks from chemical carcinogens were estimated at less than one occurrence in one million and zero for non-carcinogenic chemical contaminants. (NRC 2004)

NRF

Consistent with the discussion provided for INL, non-carcinogenic and carcinogenic constituents in air emissions from NRF operations do not result in adverse public health impacts.

3.13.2 Radiological Health and Safety

The ROI for occupational radiological health and safety includes INL and NRF, the location of the proposed action. The ROI for public radiological health and safety is the 80.5-kilometer (50-mile) radius from NRF.

Background Radiation Exposure

Humans are exposed to radiation from many sources in the environment, as shown in Table 3.13-1. Radioactivity is present in naturally occurring elements in the environment like soil, rocks, and living organisms. A major proportion (37 percent) of radiation exposure comes from naturally occurring radon. Background radiation exposure contributes 50 percent of the average total radiation doses that members of the general public receive. The remaining 50 percent of the average total radiation dose is associated with medical (48 percent) and other sources, such as industrial, consumer products, and occupational sources (2 percent). (NCRP 2009)

The population of the ESRP is exposed to radiation from natural background sources and industrial sources. The major source of radiation exposure in this region is natural background radiation exposure from the sources described above. Industrial sources of radioactivity related to INL activities contribute a small amount of additional radiation exposure to the population in this region. ESRP residents are expected to be exposed to similar background radiation doses as listed in Table 3.13-1.

Table 3.13-1: Sources of Radiation Exposure and Contributions to U.S. Average Individual Radiation Dose

Radiation Exposure Category	Effective Dose Equivalent	
	Sievert per year	rem per year
Background Radiation		
Radon	2.28×10^{-3}	2.28×10^{-1}
Other	8.3×10^{-4}	8.3×10^{-2}
Medical Radiation		
Computed tomography	1.47×10^{-3}	1.47×10^{-1}
Conventional radiography and fluoroscopy	3.3×10^{-4}	3.3×10^{-2}
Nuclear medicine	7.7×10^{-4}	7.7×10^{-2}
Interventional fluoroscopy	4.3×10^{-4}	4.3×10^{-2}
Other Radiation		
Occupational	5.0×10^{-6}	5.0×10^{-4}
Consumer products	1.3×10^{-4}	1.3×10^{-2}
Industrial, security, medical, and educational research	3.0×10^{-6}	3.0×10^{-4}
Total	6.2×10^{-3}	6.2×10^{-1}
Source: NCRP 2009		

General Health Effects From Radiological Exposure

Radiation interacts directly and indirectly with the atoms that form cells. In a direct action, the radiation interacts directly with the atoms of the DNA molecule or some other component critical to the survival of the cell. Since the DNA molecules make up a small part of the cell, the probability of direct action is small. Because most of the cell is made up of water, there is a much higher probability that radiation would interact with water. In an indirect action, radiation interacts with water and breaks the bonds that hold water molecules together, producing reactive free radicals that are chemically toxic and destroy the cell. The body has mechanisms to repair damage caused by radiation. Consequently, the biological effects of radiation on living cells may result in one of three outcomes: (1) injured or damaged cells repair themselves, resulting in no residual damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes and causing no health effects; or (3) cells incorrectly repair themselves, which results in damaging or changing the genetic code (i.e., DNA) of the irradiated cell. Stochastic effects may or may not occur based on chance, may occur when an irradiated cell is incorrectly repaired rather than killed. The most significant stochastic effect of radiation exposure is that an incorrectly repaired cell may, after a prolonged delay, develop into a cancer cell. (NRC 2011)

The biological effects on the whole body from radiation exposure depend on many factors, such as the type of radiation, total dose, time interval over which the dose is received, and part of the body that is exposed. Not all organs are equally sensitive to radiation. The blood-forming organs are most sensitive to radiation; muscle and nerve cells are relatively insensitive to radiation. Health effects may be characterized according to two types of radiation exposure: (1) a single exposure to high doses of radiation for a short period of time (acute exposure), which may produce biological effects within a short time after exposure, and (2) long-term, low-level overexposure, commonly called continuous or chronic exposure. High doses of radiation can cause death. Other possible effects of a high radiation dose include erythema (redness of skin), dry/moist scaling or shedding of skin, hair loss, sterility, cataracts, and acute radiation syndromes. Currently there are no data to unequivocally establish the occurrence of cancer following radiation exposure to low doses and dose rates below about 0.1 Sievert (10 rem). (NRC 2011)

Health effects are calculated based on the radiation exposure dose results to an individual or population group. Health effects from radiation exposure were used to summarize and compare results in this EIS. Fatal cancer is reported because cancer is the principal potential health effect which may result from radiation exposure. Cancer can occur from one to many years after the radiation exposure takes place. Appendix F, Section F.2.5 provides a more detailed discussion of the evaluation of health effects from radiation exposure.

3.13.2.1 Occupational Radiological Health and Safety

INL

Occupational health conditions at INL were previously described in DOE 2002c. Occupational radiological exposures are typically maintained at levels well below DOE occupational radiation exposure limits through the implementation of radiation protection procedures that emphasize maintaining radiation exposures as low as reasonably achievable (ALARA).

Routine radiation exposure measurements of INL workers have been used to assess potential health effects. Radiation workers at INL can be exposed to radiation internally (from inhalation and ingestion) and externally (from direct exposure). In general, the largest fraction of occupational dose received by INL workers is external radiation from direct exposure (DOE 2002c). The average occupational dose at INL between 2007 and 2009 was 0.000065 Sievert (0.0065 rem), a value below the 0.02 Sievert (2.0 rem) total effective dose equivalent administrative control level (DOE 2010c), and well below the federal annual occupational exposure limit of 5 rem in 10 C.F.R. § 835.

NRF

The policy of the NNPP is to reduce exposure to personnel from radiation associated with NNPP facilities to a level ALARA. Since its inception, the NNPP has stressed the reduction of personnel radiation exposure. Measures taken to reduce radiation exposure include standardization and optimization of procedures, development of new tooling, improved use of shielding, and compliance with strict contamination control measures. For example, most work involving radioactive contamination is performed in total containment. This practice minimizes the potential for spreading contamination and thus reduces work disruptions, simplifies working conditions, and minimizes the cost and radiation exposure during cleanup. NRF is required to have an active program to keep radiation exposure ALARA. (NNPP 2011b)

ECF is designed so that radioactive material outside of reactor plants is handled only in specially designed and shielded facilities. NNPP facilities minimize the number of places where radioactive material is allowed. Stringent controls are in place during the movement of all radioactive material. A radioactive material accountability system is used to ensure that no radioactive material is lost or misplaced. Regular inventories are required for every item in the radioactive material accountability system. Radioactive material is tagged with yellow and magenta tags bearing the standard radiation symbol and the measured radiation level. Radioactive material has to be conspicuously marked and placed in yellow plastic, the use of which is reserved solely for radioactive material. All personnel assigned to NNPP facilities are trained to recognize that yellow plastic identifies radioactive material and to initiate immediate action if radioactive material is discovered out of place. (NNPP 2011b)

Access to radiation areas is controlled by posted signs and barriers. Personnel are trained in the access requirements, including the requirement to wear dosimetric devices to enter these areas. Dosimetric devices are also posted near the boundaries of these areas to verify that personnel outside these areas do not require monitoring. Frequent radiation surveys are required, using instruments that are checked for proper response before use and calibrated regularly. Areas where radiation levels are greater than 0.001 Sievert (0.1 rem) per hour are controlled as “high radiation areas” and are locked or guarded. Compliance with radiological controls requirements is checked frequently by radiological controls personnel, as well as by other personnel not affiliated with the radiological controls organization. (NNPP 2011b)

Periodic radiological controls training is performed to ensure that all workers understand: (a) the general and specific radiological conditions which they might encounter, (b) their responsibility to the NNPP and the public for safe handling of radioactive materials, (c) the risks associated with radiation exposure, and (d) their responsibility to minimize their own radiation exposure. Training is also provided on the biological risk of radiation exposure to the unborn child. Before being authorized to perform radioactive work, an employee is required to pass a radiological controls training course, including written and practical examinations, for the type of work being performed. A typical course for workers ranges from 16 to 32 hours. In written examinations on radiological controls, short answer questions (such as multiple choice and true-false) are prohibited. Production supervisors who oversee radiological work are required to have at least the same technical knowledge and abilities as the workers; however, passing scores for supervisors' examinations are either higher or more difficult to attain than they are for workers.

Lessons learned during radioactive work and new ways to reduce radiation exposure developed at one organization are made available for use by other organizations in the NNPP. This effort allows all of the organizations to take advantage of the experience and developments at one organization and minimizes unnecessary duplication of effort. (NNPP 2011b)

The extensive efforts that have been taken to reduce radiation exposure at NNPP facilities have also had other benefits, such as improved reliability. Among other things, detailed work planning, rehearsing, containment, special tools, and standardization have increased efficiency and improved access to perform maintenance. The overall result is improved reliability and reduced costs. (NNPP 2011b)

The NNPP limits an individual’s radiation dose to 0.05 Sievert (5 rem) per year not to exceed 0.03 Sievert (3 rem) in one quarter. Engineering controls such as time in the radiation area, distance away from the source, and shielding are also used in conjunction with these control levels to keep exposures ALARA. Annually, the NNPP publishes a report on the occupational radiation exposure from all NNPP DOE facilities including the prototype facilities and NRF. Since 1979, no individual has received more than 0.02 Sievert (2 rem) of exposure in a single year as a result of working at the NNPP’s DOE facilities. This is less than half the federal annual occupational exposure limit in 10 C.F.R. § 835 and 10 C.F.R. § 20 of 5 rem. The average exposure per person monitored at the prototype facilities and NRF since 1979 is about 0.0006 Sievert (0.06 rem) per year. According to the standard methods for estimating risk, the lifetime risk to the group of personnel occupationally exposed to radiation associated with the NNPP is less than the risk these same personnel have from exposure to natural background radiation. This risk is small compared to the risks accepted in normal industrial activities and to the risks regularly accepted in daily life outside of work. (NNPP 2011b)

Since 1979, the average exposure of 0.0006 Sievert (0.06 rem) per year for NRF personnel is approximately one-sixth the average annual exposure to a member of the population in the U.S. from natural background radiation, less than one-fourth the average annual exposure to a member of the population in the U.S. from common diagnostic medical x-ray procedures, and less than the difference in the annual exposure due to natural background radiation between Denver, Colorado and Washington, D.C. (NNPP 2011b). Decreases in annual radiation exposure have been achieved as a result of continuing efforts to reduce radiation exposures to the minimum practicable. Table 3.13-2 provides additional perspective.

Table 3.13-2: Comparison of Radiation Exposure of Naval Spent Nuclear Fuel Handling Workers to U.S. Populations

Population	Annual Exposure	
	Sievert	rem
Naval Spent Nuclear Fuel Handling Workers	0.0006	0.06
Perspective:[1]		
U.S. Population (Normal Background)	0.0031	0.31
Aviation	0.0031	0.31
Diagnostic Medical X-ray	0.0008	0.08
Commercial Nuclear Plant Personnel	0.0019	0.19
[1] Source: NCRP 2009		

According to 2010 exposure data for individuals involved in naval spent nuclear fuel handling operations, the highest average annual exposure of 0.00018 Sievert (0.018 rem) was obtained by technicians who unload shipping containers. These exposures are even lower than the historical running average of 0.0006 Sievert (0.06 rem) for which perspective is provided above. The historical running average includes data since 1979.

3.13.2.2 Public Radiological Health and Safety

INL

The ROI for the affected environment for general health effects from radiation exposure and emissions includes the INL area monitoring network shown in Figure 3.6-3.

Industrial sources of radiation to the public around INL include radiation released from activities occurring within INL. These activities can release radioactivity either directly (e.g., through stacks or venting) or indirectly, (e.g., through re-suspension of radioactivity from disturbing contaminated soils). Previous environmental documentation for the INL indicates airborne emissions represent the primary pathway of concern for potential public health impacts (DOE 2002c). The radiological dose to the public surrounding INL is too small to be measured by available monitoring techniques. Both non-radiological and radiological emissions are described in detail in Section 3.6. (NRC 2011)

Table 3.13-3 provides the health effects from annual radiation exposure to routine airborne releases at INL in 2007, 2008, and 2009 for the INL MEI. According to ESER 2010, the INL MEI is screened to be a hypothetical person living at Frenchman's Cabin who would receive the highest potential dose. Frenchman's Cabin is located at the southern boundary of INL (Figure 3.13-1), and is only inhabited during portions of the year. This location must be considered as a potential INL MEI location according to NESHAP (ESER 2010). The estimated doses are well below the 10 millirem per year limit provided in 40 C.F.R. § 61.

The health effects to the general population and fatal cancer from annual radiation exposures in 2007, 2008, and 2009 are provided in Table 3.13-4. The development of fatal cancer estimated in the population from the annual estimated radiation exposure levels is less than one chance in 2300 individuals. This likelihood of developing fatal cancer is very low in comparison to the 22,650 individuals (1 in 6.7) living within an 80.5-kilometer (50-mile) radius of NRF that would die from cancer from a lifetime of normal activity unrelated to NRF radiological emissions (Appendix F, Section F.2.6). The likelihood for the population surrounding INL is similar.

Table 3.13-3: Health Effects to INL MEI From INL Releases

Maximally Exposed Individual	Annual Dose[1]		Fatal Cancer[2]
	Sievert	rem	
Off-site Public Individual (2007)	9.3×10^{-7}	9.3×10^{-5}	5.1×10^{-8}
Off-site Public Individual (2008)	1.3×10^{-6}	1.3×10^{-4}	7.2×10^{-8}
Off-site Public Individual (2009)	6.9×10^{-7}	6.9×10^{-5}	3.8×10^{-8}

[1] Sources: ESER 2008, ESER 2009, and ESER 2010

[2] To convert dose to fatal cancer, a factor of 5.5×10^{-4} per rem is multiplied by the annual dose (ICRP 2007). In determining a means of assessing health effects from radiation exposure, the International Commission on Radiological Protection (ICRP) has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population, and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

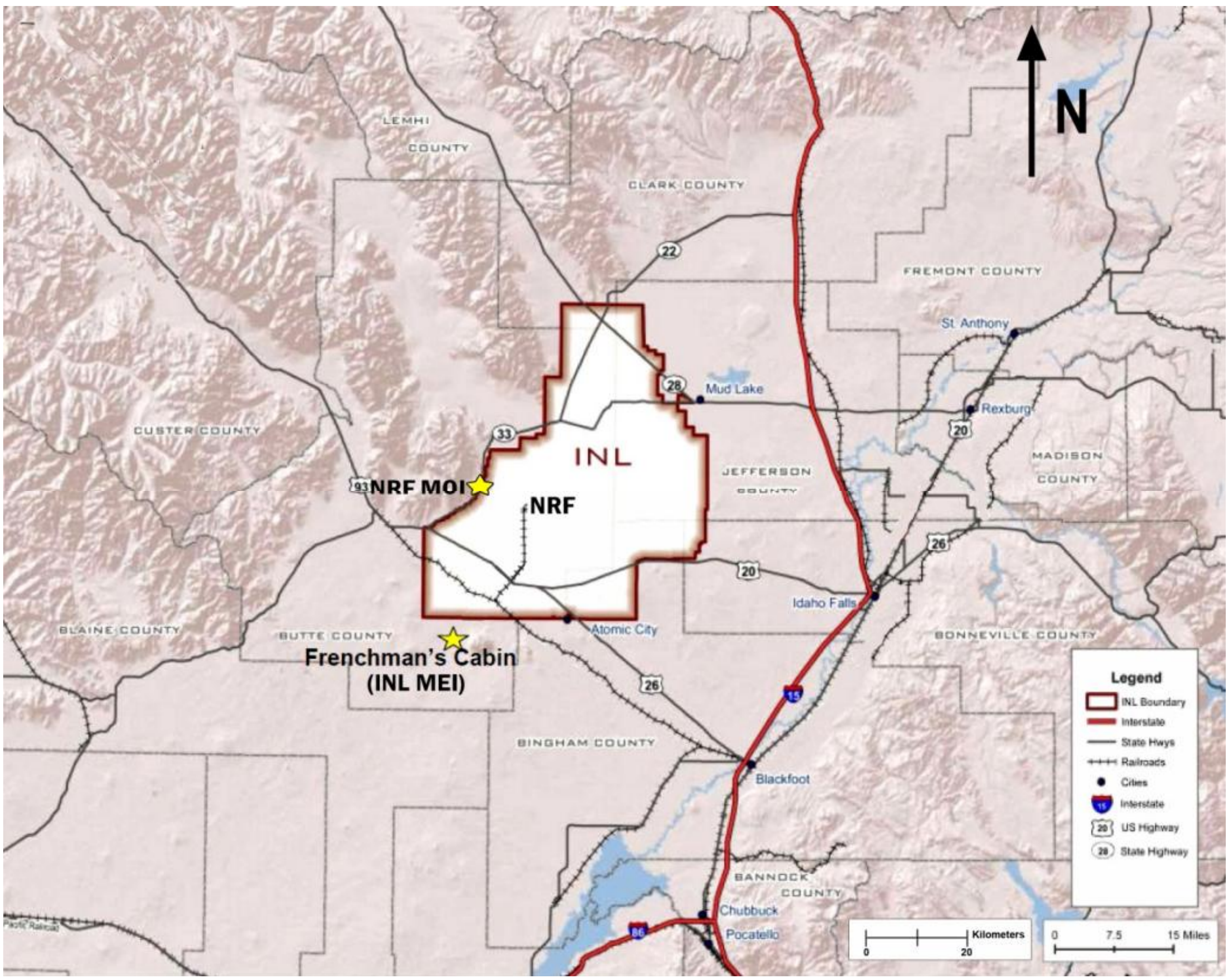


Figure 3.13-1: Location of Maximally Exposed Individuals

Table 3.13-4: Health Effects to Population From INL Radiological Releases

Year	Population Dose[1]		Fatal Cancer[2]
	person-Sievert	person-rem	
2007	0.0032	0.32	0.00018
2008	0.0078	0.78	0.00043
2009	0.0052	0.52	0.00029

[1] Source: ESER 2008, ESER 2009, and ESER 2010
[2] To convert dose to fatal cancer, a factor of 5.5×10^{-4} per rem is multiplied by the annual dose (ICRP 2007). In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population, and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

NRF

Radiation exposure to any member of the public due to NRF operations is a very small number. The maximum possible annual dose to a member of the public resulting from site operations can only be calculated using conservative assumptions of release and human uptake.

The Hanford Dosimetry System Generation II (GENII) code is used for atmospheric dispersion modeling to assess the impact radiological air emissions from NRF and ECF currently have on the environment. The NRF Maximally Exposed Off-Site Individual (MOI) is used in the evaluation. The NRF MOI is a theoretical individual with the characteristics and habits of an adult member of the public living at the INL property boundary. The NRF MOI is located approximately 10.5 kilometers (6.5 miles) away from NRF in the west-northwest direction (Figure 3.13-1). The NRF MOI is defined differently from the INL MEI because the INL MEI considers emissions from the entire INL while the NRF MOI only considers emissions from NRF. Both airborne and waterborne (surface water and groundwater) radiation exposure pathways are evaluated to account for the NRF MOI's direct exposure to the contaminated air plume and ingestion of surface water and groundwater contaminated by radionuclides deposited by the air plume.

Table 3.13-5 provides health effects from annual radiation exposure to routine airborne releases at NRF and ECF in 2009 for the NRF MOI. As shown in Table 3.6-23, ECF contributes the majority of NRF emissions. Therefore, it is not surprising that the dose from NRF releases is calculated to be equivalent to the dose from ECF releases.

For perspective, the dose results for the NRF MOI are calculated to be 2.9×10^{-9} Sievert (2.9×10^{-7} rem) in the 2009 NESHAP Report (DOE 2010a). This is far less than the approximately 0.003 Sievert (0.3 rem) the average U.S. citizen receives from naturally occurring radiation sources every year, and is less than 1/1000 of the additional radiation exposure that an individual would receive from a single cross-country airplane flight. In addition, the estimated doses are well below the 10 millirem per year limit provided in 40 C.F.R. § 61.

The health effects to the population within a 80.5-kilometer (50-mile) radius of NRF and fatal cancer from annual NRF and ECF radiation exposures in 2009 are provided in Table 3.13-6. The development of fatal cancer estimated in the population for the next 70 years from the annual estimated radiation exposure levels is less than one chance in 200,000. This likelihood of developing fatal cancer is very low in comparison to the 22,650 individuals (1 in 6.7) living within an 80.5-kilometer (50-mile) radius of NRF that would die from cancer from a lifetime of normal activity unrelated to NRF radiological emissions (Appendix F, Section F.2.6).

Table 3.13-5: Health Effects to NRF MOI From 2009 NRF and ECF Releases

Annual Dose				Fatal Cancer[1]
ECF		NRF		
Sievert	rem	Sievert	rem	
2.7×10^{-9}	2.7×10^{-7}	2.7×10^{-9}	2.7×10^{-7}	1.5×10^{-10}

[1] To convert dose to fatal cancer, a factor of 5.5×10^{-4} per rem is multiplied by the annual dose (ICRP 2007). In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population, and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

Table 3.13-6: Health Effects to Population From 2009 NRF and ECF Releases

Population Dose				Fatal Cancer[1]
ECF		NRF		
person-Sievert	person-rem	person-Sievert	person-rem	
9.0×10^{-5}	9.0×10^{-3}	9.0×10^{-5}	9.0×10^{-3}	5.0×10^{-6}

[1] To convert dose to fatal cancer, a factor of 5.5×10^{-4} per rem is multiplied by the annual dose (ICRP 2007). In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

INL and NRF are very small sources of radiation exposure. Figure 3-13.2 provides perspective about the fraction of radiation exposure to an individual from INL and NRF when compared with other common sources. The levels of radiation exposure from natural background, medical, and consumer products are provided in Table 3.13-1. The fraction of radiation exposure to an individual due to INL releases is provided in Table 3.13-3, and the fraction of radiation exposure to an individual for NRF releases is found in Table 3.13-5. The individual radiation exposure from NRF releases is approximately 0.04 percent of the total individual radiation exposure from INL releases; the individual radiation exposure from INL releases is approximately 0.03 percent of the individual radiation exposure received from natural background radiation.

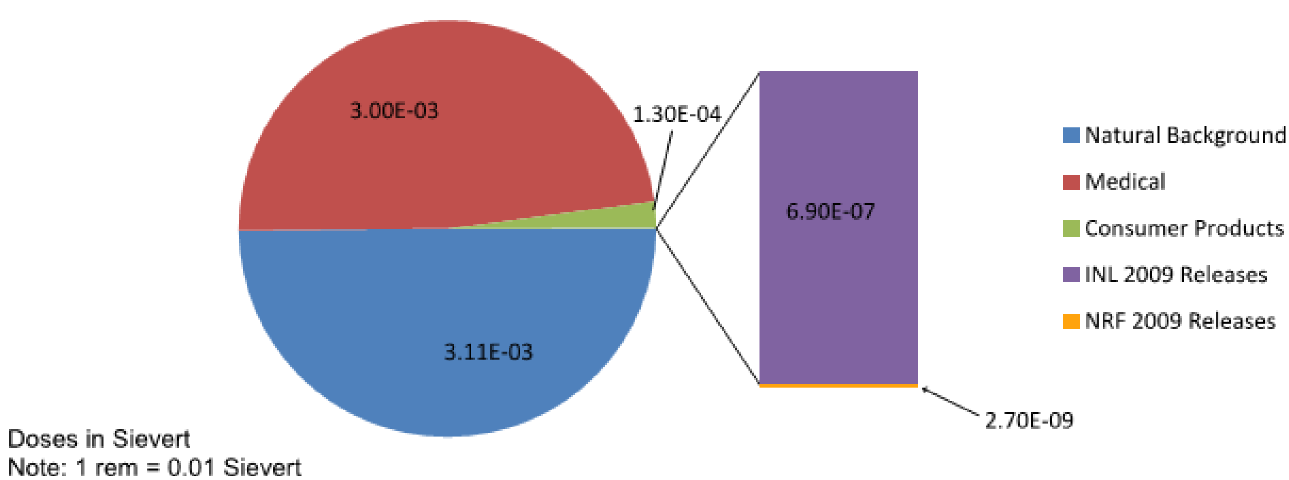


Figure 3.13-2: Sources of Radiation Exposure

3.14 Waste Management

The ROI for waste management activities encompasses the INL, including NRF. INL and NRF comply with all federal and state regulations with respect to waste management. This section describes sources and volumes of wastes as well as management practices upheld during waste generation activities.

NRF has never been a manufacturing facility; consequently, the total quantities of chemical and radioactive materials handled at NRF have typically been small. When sufficient quantities are accumulated, scrap metals, lead-acid batteries, elemental lead, heavy metal-bearing equipment, cardboard, and wood are shipped off-site for recycling. NRF continues to minimize the generation of RCRA hazardous waste to the maximum extent practicable. NRF remediation activities, ECF, and support facilities generate LLW during their operations.

NRF has maintained a rigorous waste control and minimization program for many years. NRF has a waste minimization plan which requires specific actions to identify and minimize waste producing operations, compare minimization efforts year to year to demonstrate progress, and establish waste minimization goals. This is accomplished by establishment of strict procurement procedures, substitution of non-hazardous materials where practicable, and other similar measures.
Typical actions taken in recent years include:

- Recycling of lead acid batteries.
- Careful control of the use of chemicals to minimize RCRA hazardous constituents and to minimize the amount of excess chemicals that must be disposed of after completion of jobs.
- Training of employees to understand the hazards and to follow the proper controls for the potentially RCRA hazardous materials used in their jobs.
- Replacement of fluorescent light tubes with non-hazardous substitutes.
- Changing out polychlorinated biphenyl (PCB)-containing light ballasts with a non-PCB alternative.

NRF requires environmentally sound management of wastes by the contractors selected for on-site work. NRF requires that contractors' practices conform to all applicable regulations and, when practicable, use advanced disposal technology for NRF wastes. NRF continues to evaluate chemical purchases and waste producing operations, identifying ways to further reduce the generation of RCRA hazardous wastes.

Table 3.14-1 lists the various waste streams discussed throughout this section and their subsequent definitions.

Table 3.14-1: Waste Streams and Definitions

Waste Stream	Definition
Non-hazardous solid waste	Waste that has no RCRA hazardous, PCB, or radioactive constituents. Asbestos may be included in this waste stream.
Recyclable material	Material that can be recycled.
RCRA hazardous waste	Under RCRA Subtitle C, waste that exhibits a RCRA hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) is a listed hazardous waste, and/or contains a hazardous waste.
TSCA waste	TSCA regulates the use, management, and disposal of certain chemicals, particularly PCBs, which are a synthesized class of chemical substances that have been banned from production since the early 1980's. Asbestos is also regulated per TSCA and is managed on-site per 40 C.F.R. 61 Subpart M regulations, but does not require disposal in TSCA-approved disposal sites per regulation.
Radioactive TSCA waste	Same as TSCA waste defined above, but with radiological constituents.
MLLW	Waste that contains both radioactive and RCRA hazardous constituents.
TSCA MLLW	Waste that contains TSCA, radioactive, and RCRA hazardous constituents.
LLW	Radioactive waste that is not spent nuclear fuel, high-level waste, or TRU waste. Asbestos may be included in this waste stream.
High-level waste	Waste that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of TRU and fission products in quantities that require permanent isolation.

3.14.1 Non-Hazardous Solid Waste and Recyclable Material

Non-hazardous solid waste at NRF generally consists of routine waste generated by personnel on-site. Asbestos waste is disposed as non-hazardous solid waste. Non-hazardous solid waste is primarily disposed of at the INL CFA Landfill Complex. The INL CFA Landfill Complex is located approximately 16 kilometers (10 miles) south of NRF and is operated in accordance with state of Idaho regulations. In 2010, the remaining capacity of the INL CFA Landfill Complex was 3.4 million cubic meters (4.5 million cubic yards). Non-hazardous solid waste items that cannot be disposed at the INL CFA Landfill Complex are sent off-site to a commercial disposer.

As much as possible, recyclable materials are segregated from the solid waste stream in accordance with waste minimization and pollution prevention protocols. Most solid metal waste is accumulated and sold to a scrap salvage vendor. In addition, aluminum beverage containers and cardboard material are collected for recycling. Scrap wood is sent to the INL CFA Landfill Complex to be chipped and reused for mulch.

Table 3.14-2 summarizes the annual average of non-hazardous solid waste and recyclable material generated at NRF and INL. Routine wastes are generated from activities associated with day-to-day work. Decontamination and decommissioning (D&D) wastes are generated from activities such as removal of obsolete buildings and equipment and from maintenance, where waste is generated from non-routine activities that are necessary to keep facilities operating in an environmentally responsible manner.

Table 3.14-2: Average Generation of Non-Hazardous Solid Waste and Recyclable Material

Facility	Non-Hazardous Solid Waste				Recyclable Material	
	Routine Activities		D&D Activities			
	cubic meters	cubic yards	cubic meters	cubic yards	cubic meters	cubic yards
INL[1]	2100	2700	3300	4400	6700[2]	8800
NRF[1]	4600	6000	2500	3300	1400[3]	1800

[1] INL data are from 2006-2010 (except as noted); NRF data are from 2005-2009.
[2] Source: HSS 2009. Does not include NRF recyclable materials.
[3] Includes radioactive recyclable that may have been generated as a MLLW or LLW.

3.14.2 RCRA Hazardous Waste and TSCA Waste

Regulatory standards for generation, transportation, storage, treatment, and disposal of RCRA hazardous waste have been developed under RCRA Subtitle C. The IDEQ is authorized by the EPA to regulate RCRA hazardous waste at INL. Materials defined as hazardous in accordance with RCRA are managed in accordance with applicable regulations. TSCA, which is administered by EPA, requires regulation of the use and management of certain chemicals, particularly PCBs.

In addition to the Environmental, Safety, and Health Management System, NRF follows the INL RCRA hazardous and TSCA waste management strategy, which minimizes the generation and storage of RCRA hazardous waste and properly manages and dispositions RCRA hazardous waste and TSCA waste. Commercial treatment and disposal is also used. RCRA hazardous waste and TSCA wastes are treated and disposed at off-site facilities and are transported there by a commercial transport contractor. The waste is packaged for shipment in accordance with the waste acceptance criteria for that facility as well as all regulatory requirements. In accordance with RCRA regulations, NRF holds RCRA hazardous waste in a satellite accumulation area or a less than 90-day accumulation area, until it is shipped directly to an off-site commercial treatment facility. By regulation, these areas are not required to be permitted.

The predominant sources of RCRA hazardous waste at the INL facilities, including NRF, are from D&D activities. NRF previously removed and disposed of known TSCA waste sources from PCB-containing electrical transformers on property for which they are responsible. INL owns transformers within the NRF substation, which were retrofitted with non-PCB dielectric fluid. The remaining sources of TSCA waste at NRF are primarily from PCBs found in coated items and some lighting fixtures with PCB-containing ballasts.

Table 3.14-3 and Table 3.14-4 summarize the annual average of RCRA hazardous waste, TSCA waste, and radioactive TSCA waste generated at INL (excluding NRF) and NRF. Volumes have been included, where possible, to provide a direct comparison with data in Section 4.14.

Table 3.14-3: Average Generation of RCRA Hazardous Waste

Facility	Routine Activities		D&D Activities	
	metric tons	U.S. tons	metric tons	U.S. tons
INL[1]	22.0	24.2	2200	2420
NRF[1]	1.4 (3 cubic meters)[2]	1.5 (4 cubic yards)	1.5 (2.6 cubic meters)[2]	1.7 (3.5 cubic yards)

[1] INL data are from 2006-2010; NRF data are from 2005-2009.
[2] Weight to volume conversions impacted by shipping frequencies and container sizes.

Table 3.14-4: Average Generation of TSCA Waste

Facility	TSCA Waste[2]		Radioactive TSCA Waste[2] (Low-Level)	
	metric tons	U.S. tons	metric tons	U.S. tons
INL[1]	9.4	10.4	440	480
NRF[1]	1.6	1.8	10.3	11.4

[1] All data are from 2005-2009.
[2] Routine or D&D TSCA waste cannot be differentiated from reports used.

3.14.3 MLLW and/or TSCA MLLW

The Federal Facilities Compliance Act (FFCA) of 1992 required DOE facilities which generate and store mixed waste to prepare a Site Treatment Plan (STP) to address treatment of mixed waste. NRF was included in the INL FFCA process which issued a STP. The INL STP was approved by IDEQ in accordance with the FFCA and an implementing Consent Order was executed. The Mixed Waste Management Plan (MWMP) specifies the requirements for management of mixed waste at NRF in accordance with the state of Idaho requirements for RCRA hazardous constituents and the NNPP requirements for radiological controls.

MLLW contains both radioactive and RCRA hazardous constituents. IDEQ is authorized by EPA to regulate the RCRA hazardous components of MLLW at INL. Sources of MLLW at INL are generated from D&D and routine activities, such as testing, destructive examination, and metallographic examination. NRF generates a small amount of MLLW, primarily from D&D activities at ECF. Sources of TSCA MLLW include those similar to MLLW, except with the addition of contaminants regulated by TSCA. NRF recycles radioactive metals that would be considered MLLW if not recycled. This volume has been included in Table 3.14-2 under Recyclable Material consistent with annual reporting for these materials.

As of 2010, INL had 2100 cubic meters (2700 cubic yards) of MLLW in inventory. Table 3.14-5 summarizes the annual average generation of MLLW and TSCA MLLW (combined) at INL (excluding NRF) and NRF.

Table 3.14-5: Average Generation of MLLW and TSCA MLLW

Facility	Volume Generated	
	cubic meters	cubic yards
INL[1]	9000	12,000
NRF[2]	20	26

[1] INL data (from routine and D&D activities) are from 2006-2010.
[2] NRF data (from D&D activities) are from 2005-2009.

3.14.4 LLW

DOE Order 435.1, “Radioactive Waste Management,” was issued to ensure that all DOE radioactive waste is managed in a manner that protects the environment, worker, public safety, and health. This order, effective July 1, 1999, includes the requirements that must be met by DOE in managing radioactive waste. Naval Reactors implements this DOE Order through Implementation Bulletin Number 435.1-6.

NRF maintains a radioactive waste minimization program to identify and eliminate sources of waste generation. NRF has maintained an essentially decreasing generation rate for radioactive wastes from prototype and ECF plant operations and maintenance over the past several years. Due to the shutdown of NRF's prototypes and other operational changes, efforts have been made to reduce waste backlog and decommission areas no longer needed. Disposal of waste generated from backlog waste processing and decommissioning areas has resulted in a temporary increase of overall waste shipped from NRF compared to previous years. When feasible, NRF sends radioactive materials to waste processing vendors to be recycled, incinerated, or compacted and landfilled. Radioactive metals that are recycled are used to fabricate shield blocks that are controlled as radioactive material.

Solid radioactive wastes that are shipped to an off-site disposal facility are packaged and shipped in accordance with requirements of the Department of Transportation (DOT). On-site shipments to the RWMC meet safety requirements that are equivalent to those for shipments made in accordance with DOT requirements. This equivalency is accomplished by use of speed restrictions, escorts, and temporary road closures.

Solid LLW

Solid radioactive wastes are generated at NRF as a result of routine and D&D activities. When practicable, solid radioactive waste is dismantled or resized to reduce the volume that must be shipped for direct disposal. Included in this waste stream are process system filters, resin, contaminated components, pieces of insulation, rags, sheet plastic, paper, filter paper and towels resulting from radiochemistry and radiation monitoring operations, and ventilation filters. LLW generated at various INL facilities (including NRF) is stored temporarily at the generator facilities until it is shipped directly to a commercial facility or RWMC for disposal.

RWMC provides a subsurface disposal site for solid LLW generated by INL activities. RWMC opened in 1952; it is located near the southwestern corner of INL. Currently, RWMC comprises a total of 72 hectares (177 acres) (Giles et al. 2005). RWMC stopped accepting contact-handled (CH) LLW in 2008 and expects to stop accepting remote-handled (RH) LLW when it reaches full capacity, as part of the ongoing cleanup of INL under CERCLA. CH LLW from NRF is now disposed of through commercial waste processing vendors. DOE is planning to build a replacement facility at INL that will support NNPP RH LLW disposal needs. In December 2011, DOE published a Finding of No Significant Impact for a replacement facility at INL (DOE 2011b).

Liquid LLW

Federal regulations applicable to commercial nuclear industries allow the discharge of low-level radioactive liquids to the environment if they meet concentration standards established by the Nuclear Regulatory Commission. DOE regulations also allow similar discharges of low-level radioactive liquids. While federal and DOE regulations allow discharges of liquid LLW, no liquid LLW is discharged from NRF operations. Liquid LLW is generated at NRF through the radioactive contamination of water pool water from the introduction of corrosion products from irradiated test specimens, the unloading and storage of naval spent nuclear fuel in the water pool, and from naval spent nuclear fuel processing. At NRF, water used for radiological purposes is collected, processed to remove the radioactivity, and reused. The reuse processing systems include collection tanks and particulate filters, as well as resin to remove inorganics. The water is reused in operations involving radioactivity to the maximum extent practicable. The water reuse practices assure that over 99.9 percent of the gamma radioactivity contained in liquids associated with NRF site operations is removed by various methods, including filters and resins. These filters and resins are disposed of at RWMC. The remaining 0.1 percent of the radioactivity is retained in the water that is reused in the water pool.

Radioactively contaminated oil can be generated from maintaining the naval spent nuclear fuel handling equipment in ECF. Based on historical data, approximately 19 liters (5 gallons) of this liquid LLW is accumulated per year. This liquid LLW is sent off-site to be burned for fuel once it meets the treatment facility's waste acceptance criteria.

Table 3.14-6 summarizes the annual average of LLW generated at INL and NRF.

Table 3.14-6: Average Generation of LLW

Facility	Routine Activities		D&D Activities	
	cubic meters	cubic yards	cubic meters	cubic yards
INL[1]	860	1100	22,000	29,000
NRF[2]	740	960	1200	1600

[1] INL data from 2006-2010 excludes NRF.
[2] NRF data are from 2005-2009.

3.14.5 High-Level Waste

In 1953, reprocessing of spent nuclear fuel from naval reactors, test reactors, and research reactors began at INTEC, resulting in the generation of approximately 30,000 cubic meters (40,000 cubic yards) of high-level liquid wastes. These wastes were placed into interim storage in underground storage tanks at the INTEC Tank Farm. Treatment of these wastes began in 1963 through a process called calcining. Currently, approximately 4400 cubic meters (5800 cubic yards) of high-level calcine waste are stored at INTEC. According to the Idaho Settlement Agreement (SA 1995), the calcine waste is to be treated by DOE and in a road-ready configuration by December 31, 2035. INL, including NRF, does not currently generate any high-level waste, because spent nuclear fuel processing at INTEC has terminated. (NRC 2004)

3.15 Naval Spent Nuclear Fuel Management

Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. Spent nuclear fuel is measured by the weight of uranium or plutonium it contains, expressed in metric tons of heavy metal (MTHM). Typically, spent nuclear fuel is stored under water for some period of time after it is removed from a reactor so that water can provide cooling and shielding.

INL

On October 16, 1995, DOE, the U.S. Navy, and the state of Idaho entered into an agreement, the Idaho Settlement Agreement (SA 1995). Naval spent nuclear fuel is managed in accordance with SA 1995 and its 2008 Addendum (SAA 2008). Due to INL's geographic location above the SRPA, the state of Idaho prefers spent nuclear fuel to be placed in dry storage as soon as possible.

Spent nuclear fuel at INL originated from several sources, including DOE reactors located in other states, foreign research reactors the U.S. supported over the past 25 years, naval propulsion reactors, and commercial nuclear power plants (e.g., Three Mile Island Unit 2).

NRF

Naval spent nuclear fuel from nuclear-powered submarines, aircraft carriers, and prototype reactors is delivered to NRF by rail for examination and packaging into a configuration that is ready to be shipped to an interim storage facility or geologic repository. The fuel is staged in shipping containers at NRF until it is transferred to and stored in water pools or in dry storage. Some naval spent nuclear fuel was previously transferred to INTEC for storage, but is being returned to NRF for dry storage. Naval spent nuclear fuel currently in wet storage will be moved into dry storage until it can be shipped out of Idaho to an interim storage facility or geologic repository.

Table 3.15-1 summarizes the amount of spent nuclear fuel maintained at INL and NRF.

Table 3.15-1: INL Inventory of Spent Nuclear Fuel

Location	Inventory metric tons of heavy metal
INL (excludes naval spent nuclear fuel)[1]	277.64
NRF & INTEC (naval spent nuclear fuel only)[1]	32.05
[1] Inventory as of March 2016.	

4.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

In accordance with Council on Environmental Quality (CEQ) regulations, the environmental impact discussions provide the analytical detail for comparisons of environmental impacts associated with the alternatives. This chapter discusses each environmental resource that could be affected. This chapter also provides a brief description of analysis methodology, results, and conclusions. A basic, overall understanding of the environmental consequences can be gained without reading the appendices. However, those appendices are frequently cited to provide additional information on specific topics. The cumulative impacts of the alternatives and other reasonably foreseeable future actions for each resource are provided in Chapter 5.

The impact analysis in this chapter is based on the best data available during preparation of the Environmental Impact Statement (EIS). Both magnitude and duration of impacts are considered in determining the level of significance. Environmental impacts in this chapter are assessed at one of five significance levels: no impact, negligible impact, small impact, moderate impact, or large impact. Justifications for the choice of significance level are provided throughout Chapter 4.

The impact analysis in Chapter 4 is based on the timelines and durations of the alternatives described in Section 2.3. For the No Action Alternative, an operational period of 45 years is evaluated. For the Overhaul Alternative, a 33-year refurbishment period and a 12-year post-refurbishment operational period are evaluated. For the New Facility Alternative, a 3-year construction period, a 5 to 12-year transition period, and a 40-year new facility operational period are evaluated.

Impacts of the alternatives are assessed in the following resource areas: land use (Section 4.1); transportation (Section 4.2); geology and soils (Section 4.3); water resources (Section 4.4); ecological resources (Section 4.5); air quality (Section 4.6); noise (Section 4.7); cultural resources (Section 4.8); visual and scenic resources (Section 4.9); socioeconomics (Section 4.10); energy consumption, site utilities, and security infrastructure (Section 4.11); environmental justice (Section 4.12); public and occupational health and safety (Section 4.13); waste management (Section 4.14); and naval spent nuclear fuel management (Section 4.15).

Since the No Action Alternative does not meet the purpose and need for the proposed action, it is considered to be an unreasonable alternative; however, the No Action Alternative is included in the evaluations in Chapter 4 as a baseline for comparison to other alternatives. The evaluations for the No Action Alternative cover: (1) Expended Core Facility (ECF) operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

4.1 Land Use

This section discusses the potential impacts to land use from the alternatives. The Idaho National Laboratory (INL) and the lands immediately adjacent to the INL boundary comprise the Region of Influence (ROI) for the land use evaluation. Facility construction, modifications, and land disturbance would be within developed areas of the INL. Impacts to land use would occur if the land uses resulting from the proposed action are incompatible with surrounding land uses, result in a change in current land-use designation, or if a significant percentage of INL lands are disturbed for development. Activities under the proposed action would not impact current types of land uses or land-use designations; therefore, the only impacts that are evaluated are those impacts resulting from land disturbance.

As described in Section 3.1, INL occupies an area of approximately 230,700 hectares (570,000 acres) of which 18,400 hectares (45,400 acres) are currently developed for facilities and supporting infrastructure. Naval Reactors Facility (NRF) occupies approximately 1800 hectares (4400 acres), with 34 hectares (84 acres) developed for facilities and supporting infrastructure. Impacts are described as a percentage of the INL and NRF land that would be disturbed from refurbishment or construction activities (e.g. temporary facilities, staging areas, and permanent facilities) and the area that would remain permanently developed for operations (e.g. permanent facilities, roads, and utilities) after refurbishment or construction activities. To minimize impacts from construction, land area temporarily disturbed during construction at Location 3/4 or Location 6 would be revegetated with native species, or allowed to naturally reseed, depending on the situation.

4.1.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. No construction activities would occur for the No Action Alternative; therefore, there would be no impact on land use since no land would be disturbed.

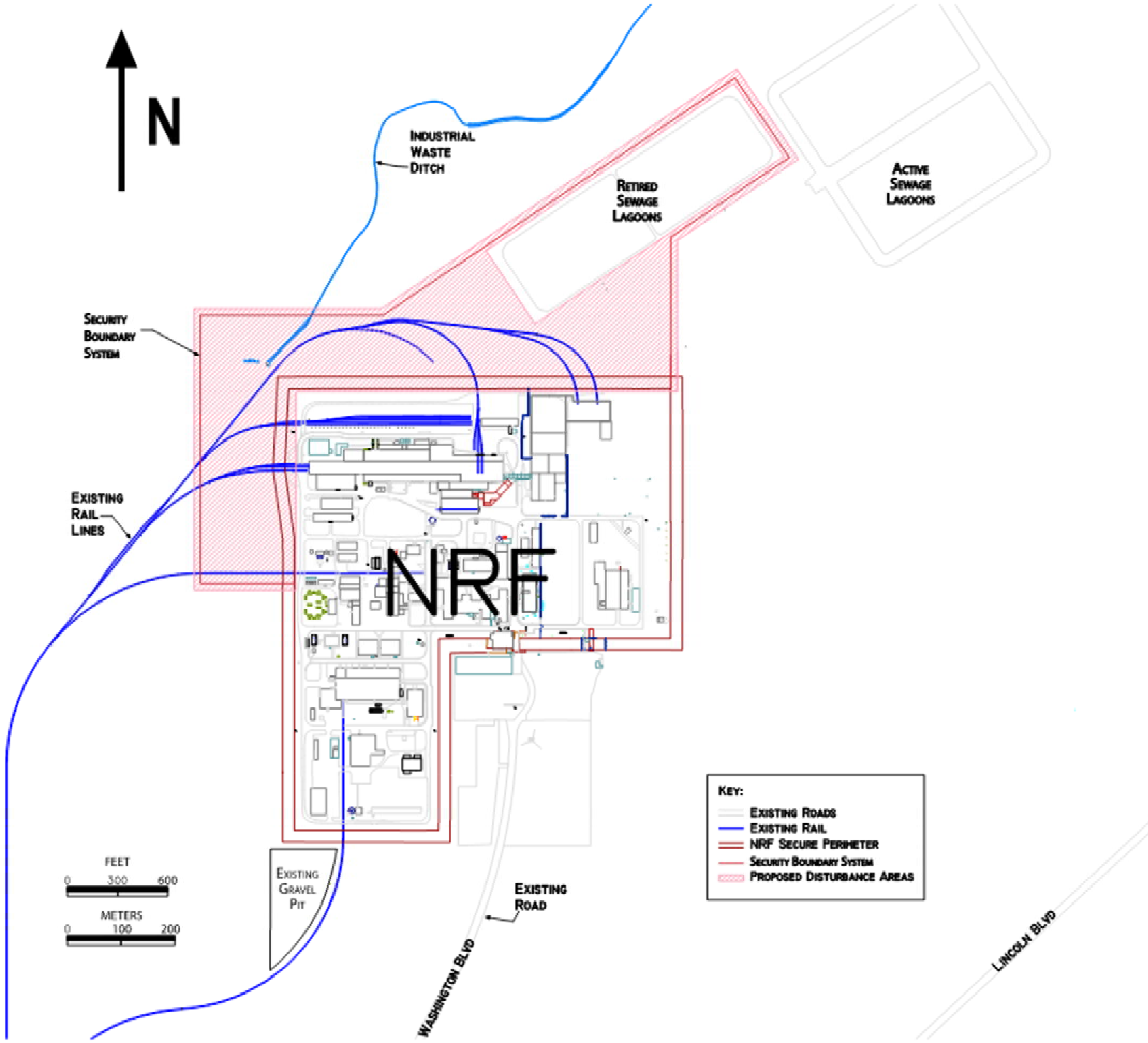
4.1.2 Overhaul Alternative

Refurbishment Period

Refurbishment activities for the Overhaul Alternative would last approximately 33 years. The only land disturbance would occur over a period of about 1 year during the refurbishment period for the construction of a new security boundary system.

The new security boundary system could include detection devices, concrete barriers with soil backing, and a gravel road adjacent to the barrier. To construct the new security boundary system, approximately 20 hectares (50 acres) of land would be disturbed (Figure 4.1-1). This land disturbance represents less than 0.01 percent of the INL land area and 1.1 percent of the NRF land area.

After construction, approximately 2 hectares (4 acres) would remain permanently developed for the new security boundary system. The increase in permanently developed area would result in an increase of less than 0.01 percent to the area that is presently used for facilities and supporting infrastructure on INL. The increase in permanently developed area would result in an increase of 6 percent to the permanently developed area that is presently used for facilities and supporting infrastructure at NRF. Therefore, there would be small impacts from land disturbance associated with construction of the new security boundary system during the refurbishment period for the Overhaul Alternative.



Note: Some of the temporary land disturbance area will remain as developed following construction of the new security boundary system.

Figure 4.1-1: Temporary Land Disturbance Area for the Refurbishment Period of the Overhaul Alternative

Post-Refurbishment Operational Period

The continued operation of the ECF would not require additional land disturbance or development. Therefore, there would be no impacts from land disturbance during the post-refurbishment operational period (approximately 12 years) of the Overhaul Alternative within or outside the INL boundary.

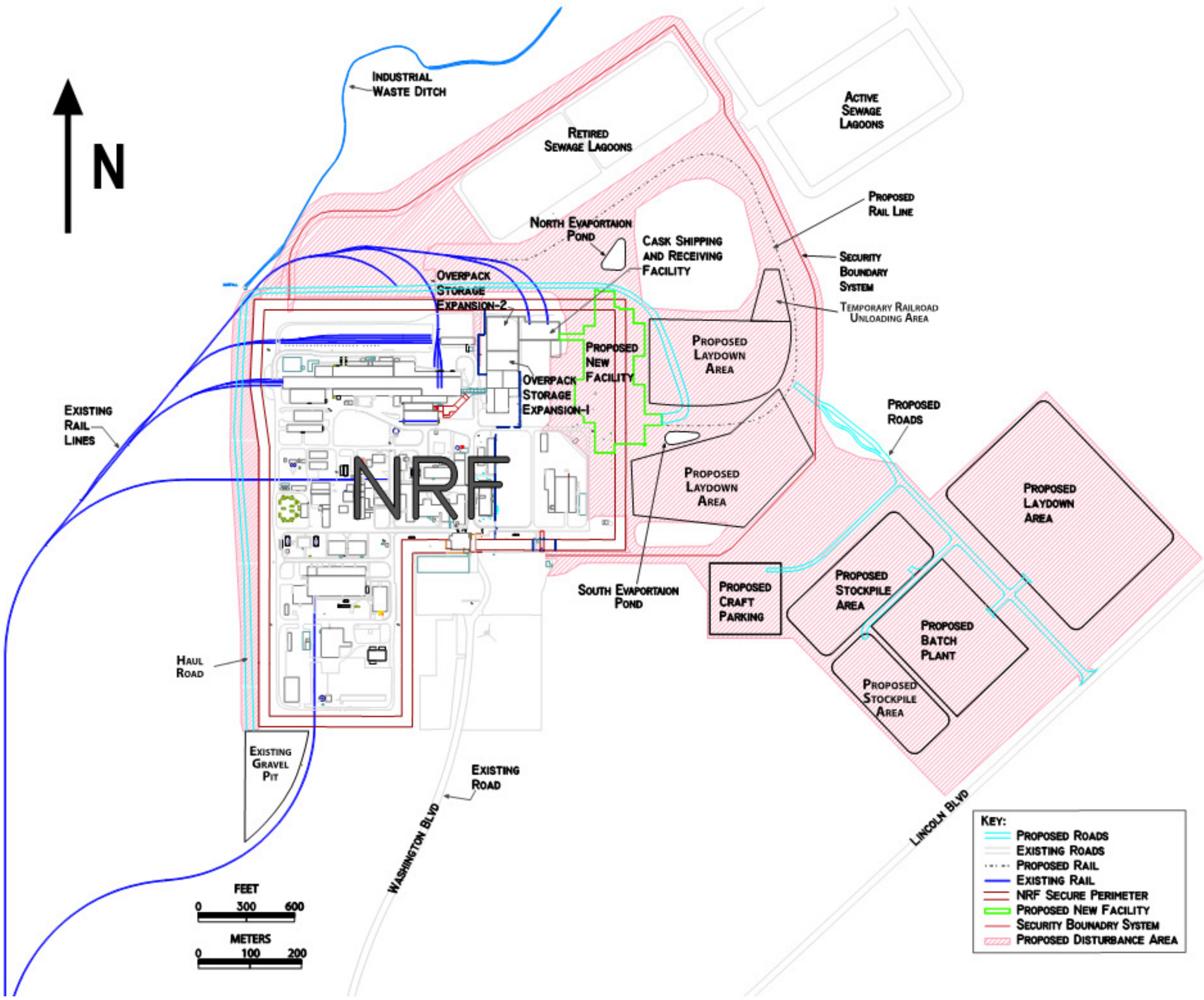
4.1.3 New Facility Alternative

Construction Period

The duration of the construction activities for the New Facility Alternative would be approximately 3 years and would occur in parallel with ECF operations. The construction period would result in land disturbance and development for permanent buildings, temporary structures, utilities, a new security boundary system, temporary roadways, new rail lines, temporary electrical lines, new electrical substation, new electrical lines, gravel pit, and a batch plant. The areas needed for all buildings, construction staging, walkways, paving, landscaping, and soil stockpiles would be cleared and grubbed. These disturbances would be within or adjacent to developed areas of NRF (Figures 4.1-2 and 4.1-3).

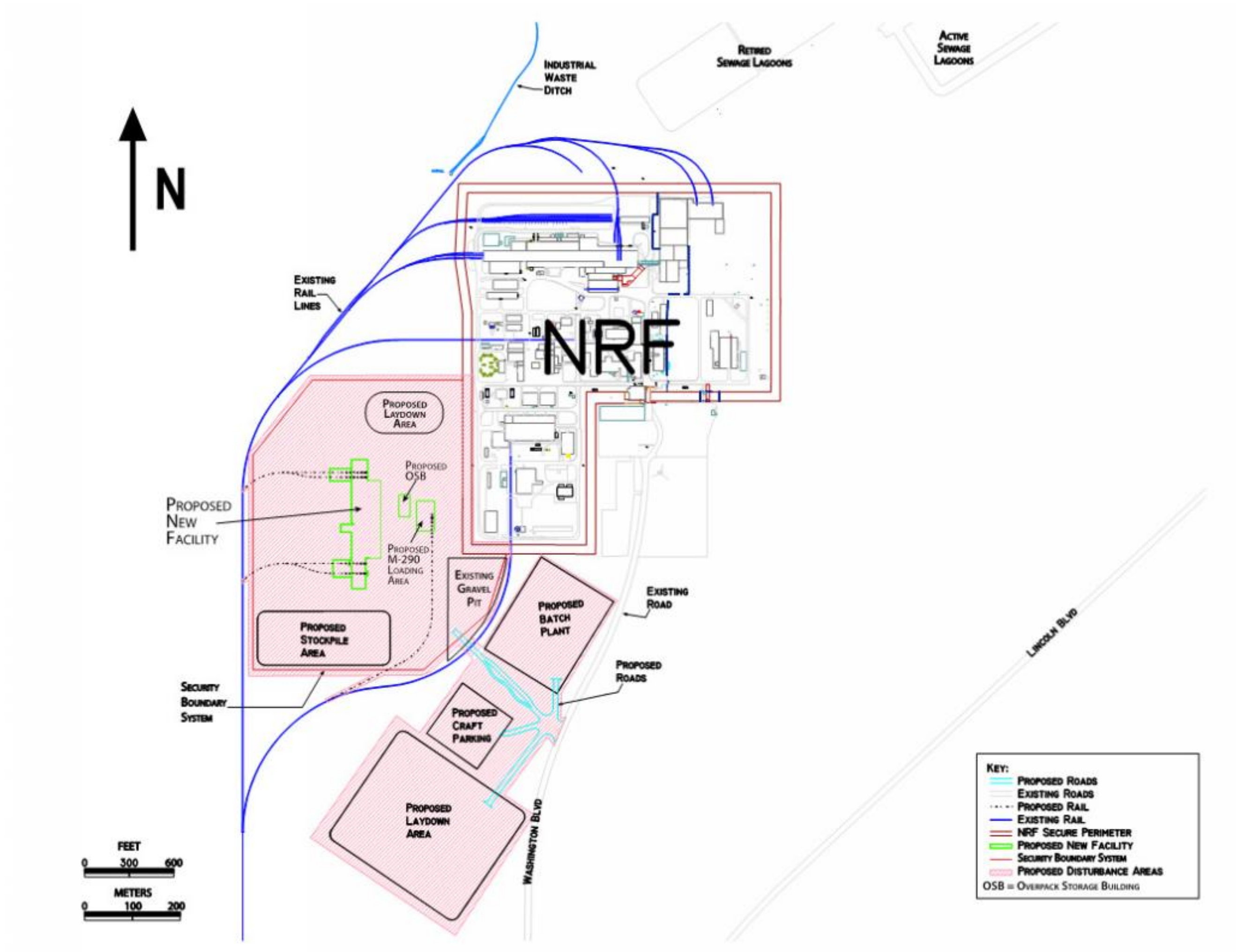
Conceptual layouts of a new facility at Location 3/4 and Location 6 are provided in Figures 2.1-3 through 2.1-5. For the New Facility Alternative, approximately 60 hectares (150 acres) would be disturbed by construction activities at either location. This disturbance area is less than 0.03 percent of INL land area and approximately 3.4 percent of the NRF land area.

After construction, approximately 16 hectares (40 acres) of the disturbed area would remain as permanently developed for use as facilities and infrastructure (including the new security boundary system). Some of the land that would be used for construction activities (e.g., laydown areas, craft parking) could remain available as support areas for future projects. The area permanently developed as facilities and infrastructure represents an increase of 0.09 percent to the amount of area at INL that is presently used for facilities and supporting infrastructure. This increase in permanently developed land represents an increase of approximately 50 percent to the area that is currently used for facilities and supporting infrastructure at NRF. However, this additional permanently developed land is less than 1 percent of the total land occupied by NRF. Because the additional land remaining as permanently developed for NRF facilities and infrastructure would be less than 1 percent of the total NRF land, the impacts from land disturbance and permanent development would be small during the construction period of the New Facility Alternative.



Note: Some of the temporary land disturbance area will remain as developed following construction.

Figure 4.1-2: Temporary Land Disturbance Area for the Construction Period of the New Facility Alternative at Location 3/4



Note: Some of the temporary land disturbance area will remain as developed following construction.

Figure 4.1-3: Temporary Land Disturbance Area for the Construction Period of the New Facility Alternative at Location 6

Transition Period

Operations of the new facility would overlap with ECF operations for a period of 5 to 12 years. These operations would be consistent with existing land use at NRF. The operation of ECF in parallel with the new facility would not require additional land disturbance or development. Therefore, there would be no impact from land disturbance during the transition period of the New Facility Alternative.

New Facility Operational Period

The New Facility Operational Period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF. These operations would be consistent with existing land use at NRF. The operation of the new facility would not require additional land disturbance or development. Therefore, there would be no impact from land disturbance during the operational period of the New Facility Alternative.

4.2 Transportation Impacts

This section discusses the potential impacts from transportation to and from NRF for the alternatives. The ROI for the transportation impacts includes the INL on-site road system, United States (U.S.) Highway 20, U.S. Highway 26, and State Route 33 (Figure 3.2-1). Impacts to transportation would occur if transportation of personnel, materials, or waste increase traffic volumes, disrupt established traffic patterns at INL, noticeably degrade traffic flow, degrade the existing transportation infrastructure, alter public transportation availability, or expose persons to radiation above federal limits.

As discussed in Section 1.5.3, transportation of naval spent nuclear fuel from shipyards and prototypes to INL and NRF was evaluated in DOE 1995. An average of 10 total shipments of naval spent nuclear fuel will be made per year to NRF over the approximate time frame of the proposed action. This average is in accordance with SA 1995 and SAA 2008 limiting the number of shipments to 20 per year (3-year running average). NRF began to receive naval spent nuclear fuel in M-290 shipping containers in 2016. The Naval Nuclear Propulsion Program (NNPP) will be ready to ship naval spent nuclear fuel in M-290 shipping containers from NRF to an interim storage facility or a geologic repository in accordance with SA 1995 and SAA 2008. Transportation impacts from shipments of naval spent nuclear fuel are the same for the alternatives. Since the rail lines cross the INL roadways at various places, there is the potential to disrupt traffic flow; however, these impacts are negligible since the shipments are infrequent.

4.2.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While operations in ECF continue, the same number of waste shipments would be required as provided in Table 3.2-2. In addition, naval spent nuclear fuel would continue to be shipped to the INL, and the number of material shipments would be expected to remain within the range described in Section 3.2. The average daily traffic in the vicinity of INL would not increase above that shown in Table 3.2-1.

If ECF operations cease, there could be a decrease in the number of waste shipments required for some waste streams as provided in Table 3.2-2. Naval spent nuclear fuel would continue to be shipped to the INL. The number of material shipments would be expected to remain within the range described in Section 3.2. The average daily traffic in the vicinity of the INL could decrease from that shown in Table 3.2-1.

The No Action Alternative would have no impact on transportation infrastructure, established traffic patterns at INL, traffic flow, the availability of public transportation, and would not expose persons to radiation above federal limits. No roads or rail lines would be added.

4.2.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations.

Transportation Infrastructure

No roads or rail lines would be added; therefore, there would be no impact to transportation infrastructure during the refurbishment period of the Overhaul Alternative.

Transportation of Personnel

During the refurbishment period of the Overhaul Alternative, traffic would increase to and from INL due to the daily commute of an average of 180 refurbishment workers per year (Section 4.10). Based on data provided in Table 3.2-1, the daily traffic commute is split between U.S. Highway 20, U.S. Highway 26, and State Route 33. Based on a conservative commuting density of one vehicle per refurbishment worker, the average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 over the refurbishment period is estimated to be 3 percent. Therefore, the impacts from transportation of personnel during the refurbishment period for the Overhaul Alternative would be small on U.S. Highway 20, U.S. Highway 26, and State Route 33. There would be no impact to public transportation availability from the transportation of personnel during the refurbishment period of the Overhaul Alternative.

Transportation of Materials

Materials would be transported to support the refurbishment period of the Overhaul Alternative. These materials would include concrete, crane components, steel, and other miscellaneous materials. Approximately 10,500 shipments would be expected over the course of the 33-year refurbishment period, averaging approximately one additional shipment each day. Although there would be an increase in the amount of materials shipped, these shipments would be spread over the refurbishment period; therefore, there would be a negligible impact from transportation of materials during the refurbishment period of the Overhaul Alternative.

Transportation of Non-Hazardous Waste, Resource Conservation and Recovery Act (RCRA) Hazardous Waste, and Recyclable Material

Non-hazardous waste, RCRA hazardous waste (including non-radioactive Toxic Substances Control Act (TSCA) waste), and recyclable material volumes for the refurbishment period are described in Section 4.14.2. During the refurbishment period of the Overhaul Alternative, the volume of waste in each shipment would increase, but would not exceed the capacity of the routine shipment. The baseline data for the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material are provided in Table 3.2-2. There would be no increase in the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material from the baseline; therefore, there would be no impact from transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material during the refurbishment period of the Overhaul Alternative.

Transportation of Radiological Waste

Three main categories of radiological waste would be transported from NRF to a disposal site during the refurbishment period of the Overhaul Alternative:

- Radioactive TSCA wastes
- Mixed low-level radioactive wastes (MLLW)
- Solid low-level radioactive wastes (LLW)
    - Remote-Handled (RH) LLW
    - Contact-Handled (CH) LLW

Radiological waste transported off-site would be packaged and shipped in accordance with requirements of the Department of Transportation (DOT) by specially trained personnel. For on-site shipments to the Radioactive Waste Management Complex (RWMC) or its replacement, the shipments would meet U.S. Department of Energy (DOE) safety requirements that are equivalent to those for shipments made in accordance with DOT requirements. This equivalency is accomplished with the use of speed restrictions, escorts, and temporary road closures. There would be no impact from radiation exposures since exposures would not exceed those allowed by federal standards.

For the refurbishment period of the Overhaul Alternative, radioactive TSCA waste and MLLW would be shipped at the same rate as provided in Table 3.2-2. There would be no change in the number of shipments. The volume of radioactive TSCA waste and MLLW in each shipment would increase as indicated in Section 4.14.2, but would not exceed the capacity of the routine shipment. There would be no impact from transportation of radioactive TSCA waste and MLLW during the refurbishment period of the Overhaul Alternative.

During the refurbishment period of the Overhaul Alternative, solid LLW in the form of RH LLW and CH LLW would be generated from refurbishment and naval spent nuclear fuel handling operations as described in Section 4.14.2. An additional 105 solid LLW shipments would be made per year during the refurbishment period of the Overhaul Alternative. Based on the current annual average number of solid LLW shipments provided in Table 3.2-2 (38 shipments), this represents a 276 percent increase in solid LLW shipments per year during the refurbishment period of the Overhaul Alternative. However, this is only an increase of approximately one truck shipment per day. The RH LLW would be shipped to the RWMC or its replacement, and the CH LLW would be transported off-site. Most solid LLW is CH LLW and would be shipped off-site. Therefore, since there would only be approximately one additional shipment per day, there would be a negligible impact from transportation of solid LLW.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF.

<u>Transportation Infrastructure</u>

No roads or rail lines would be added; therefore, there would be no impact to transportation infrastructure during the post-refurbishment operational period of the Overhaul Alternative.

<u>Transportation of Personnel</u>

During the post-refurbishment operational period, the number of naval spent nuclear fuel handling workers would increase by approximately 80 to account for operational inefficiencies in the overhauled facility and the NNPP's commitment to meeting the requirements of SA 1995, SAA 2008, and fleet demands. However, 75 percent of NRF employees ride the INL bus; therefore, only 20 additional commuters and a maximum of one additional bus would be expected during the post-refurbishment operational period. These 20 commuters and additional bus would have a negligible impact on transportation because traffic volume would increase on U.S. Highway 20, U.S. Highway 26, and State Route 33 by approximately 0.3 percent. There would be no impact to availability of public transportation for the post-refurbishment operational period of the Overhaul Alternative.

Transportation of Materials

There would be no increase in the transportation of materials during the post-refurbishment operational period of the Overhaul Alternative; the number of material shipments would be expected to remain within the range described in Section 3.2. Therefore, there would be no impact from transportation of materials during the post-refurbishment operational period of the Overhaul Alternative.

Transportation of Non-Hazardous Waste, RCRA Hazardous Waste, and Recyclable Material

Non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material volumes for the post-refurbishment operational period are described in Section 4.14.2. The volume of non-hazardous waste and recyclable material would increase but would not exceed the capacity of the routine shipment. The amount of RCRA hazardous waste generated would not increase. The baseline data for the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material are provided in Table 3.2-2. There would be no increase in the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material from the baseline; therefore, there would be no impact from transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material during the post-refurbishment operational period of the Overhaul Alternative.

Transportation of Radiological Waste

Radiological waste transported off-site would be packaged and shipped per DOT regulations by specially trained personnel. For on-site shipments to the RWMC or its replacement, the shipments would meet DOE safety requirements that are equivalent to those for shipments made in accordance with DOT requirements. This equivalency would be accomplished with the use of speed restrictions, escorts, and temporary road closures. There would be no impact from radiation exposures since exposures would be controlled and not exceed those allowed by federal standards.

For the post-refurbishment operational period of the Overhaul Alternative, radioactive TSCA waste and MLLW generation would not increase. Therefore, there would be no impact from transportation of radiological TSCA waste and MLLW for the post-refurbishment operational period of the Overhaul Alternative.

For the post-refurbishment operational period, solid LLW in the form of RH LLW and CH LLW would be generated from naval spent nuclear fuel handling operations as described in Section 4.14.2. RH LLW and CH LLW generation would exceed the current average NRF solid LLW generation rate by 16 percent (Section 4.14.2); therefore, the shipments of solid LLW could increase by approximately six shipments, or 16 percent. This is considered to be a conservative estimate to cover the uncertainties associated with the volume of waste packed per waste container. The RH LLW would be shipped to the RWMC or its replacement, and the CH LLW would be transported off-site. Most solid LLW is CH LLW and would be shipped off-site.

Since there could only be an increase of approximately six shipments of solid LLW shipments per year, there would be no impact from transportation of solid LLW during the post-refurbishment operational period of the Overhaul Alternative.

4.2.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts to transportation from construction activities of the New Facility Alternative are presented in this section in terms of increases to the baseline established in Section 3.2.

<u>Transportation Infrastructure</u>

The construction of a new facility would require temporary gravel and paved roadways on the construction site to areas like the stockpile, batch plants, and gravel pit. The dust generated from construction and use of these roadways is evaluated in Section 4.6.1.5. Land disturbance for these roadways is accounted for in Section 4.1.3.

A new facility would require the addition of railroad track. Figure 4.2-1 shows the conceptual rail line for Location 3/4. Figure 4.2-2 shows the conceptual rail line for Location 6. The new rail line would have no impact on traffic flow or traffic patterns at either location. The land disturbance for the rail lines are accounted for in Section 4.1.3.

Impacts to transportation infrastructure would be small during the construction period of the New Facility Alternative due to the addition of temporary gravel and paved roadways and additional rail line.

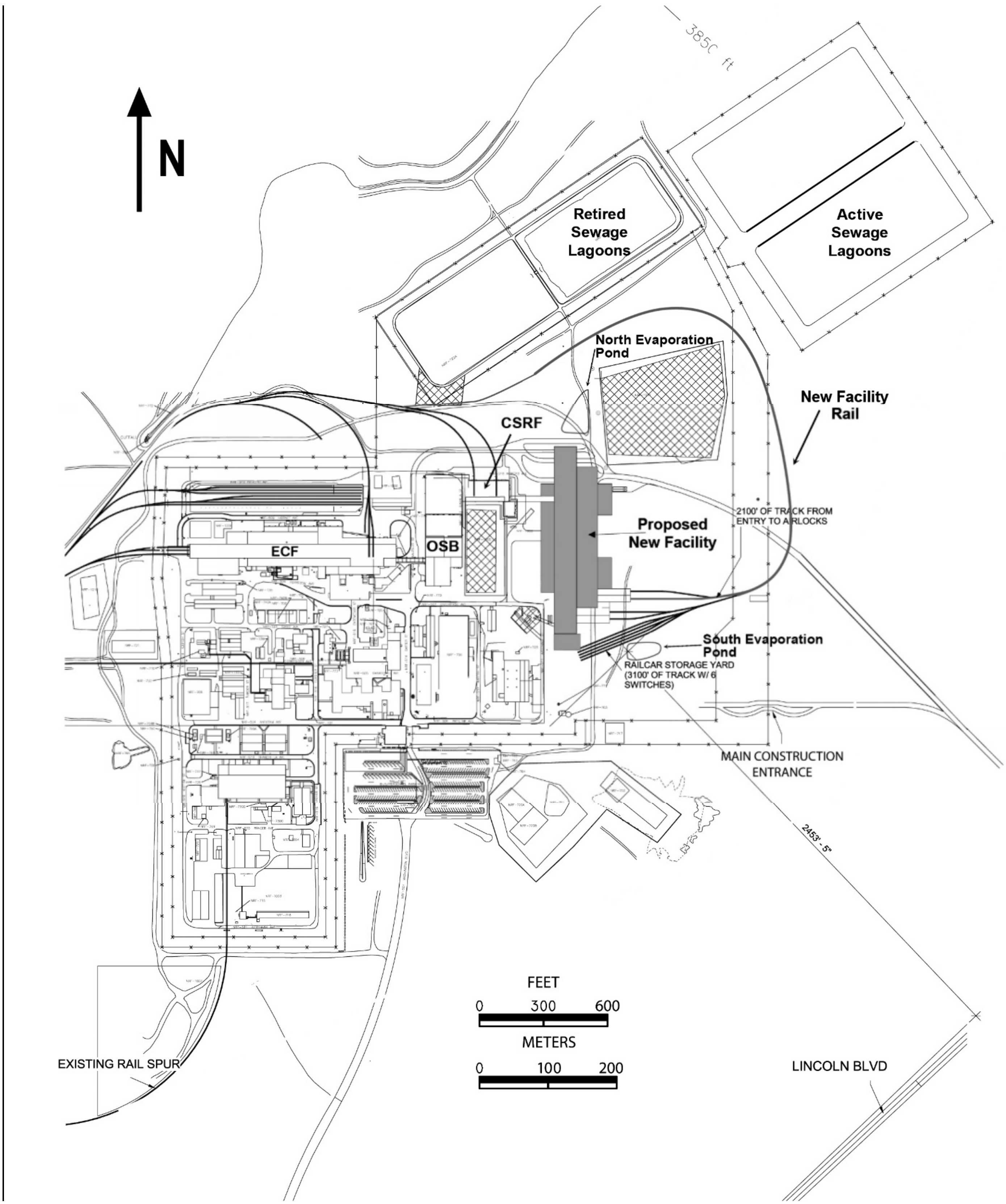


Figure 4.2-1: Conceptual Rail Line for the New Facility Alternative at Location 3/4

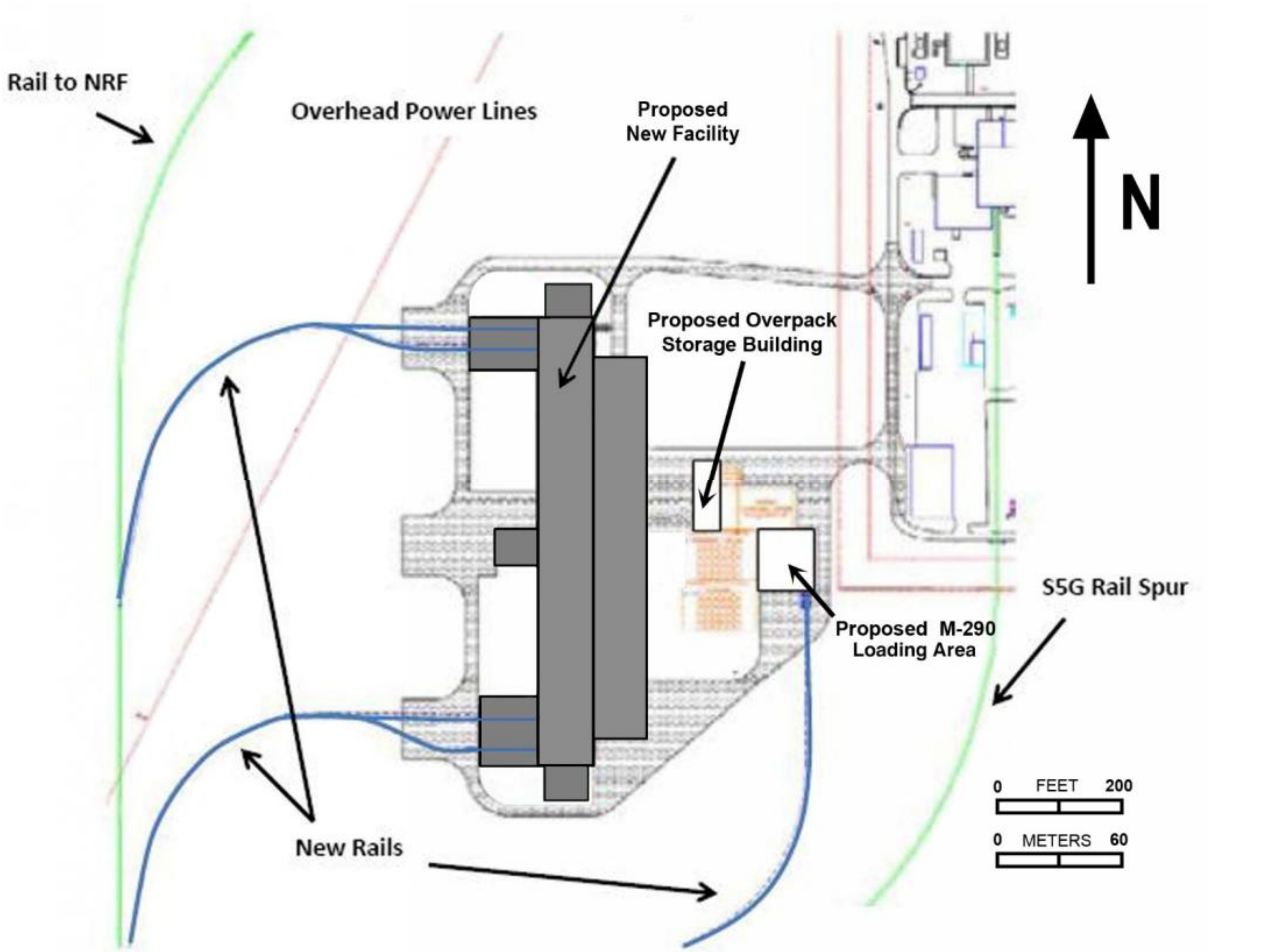


Figure 4.2-2: Conceptual Rail Line for the New Facility Alternative at Location 6

Transportation of Personnel

During the construction period for the New Facility Alternative, traffic would increase to and from NRF due to the daily commute of up to 360 construction workers per year. Based on the data provided in Table 3.2-1, the daily traffic commute is split between U.S. Highway 20, U.S. Highway 26, and State Route 33. Therefore, based on a conservative commuting density of one vehicle per construction worker driving to NRF, the average increase in daily traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 over the 3 years of new facility construction would be 6 percent. This increase in daily traffic would have a small impact to transportation on U.S. Highway 20, U.S. Highway 26, and State Route 33. There would be no impact to public transportation availability during the construction period of the New Facility Alternative.

Transportation of Materials

Construction materials (e.g., asphalt, concrete, fly ash, building cranes, piping, rebar, roofing/siding, steel, and other equipment) would be shipped to NRF during the construction period of the New Facility Alternative. Table 4.2-1 presents the increase in the number of truck shipments during construction.

Table 4.2-1: Truck Shipments of Construction Materials for the New Facility Alternative

Location	Year 1	Year 2	Year 3	Total
Location 3/4	11,000	7600	2400	21,000
Location 6	12,500	11,000	3100	26,600

Approximately 5600 more truck shipments would be necessary at Location 6 during the construction period of the New Facility Alternative because the functionality of the Cask Shipping and Receiving Facility (CSRF) and the overpack storage areas would need to be built into the new facility at Location 6.

The number of material shipments would not exceed 12,500 per year during the construction period of the New Facility Alternative. Therefore, material shipments would not exceed an estimated 50 material shipments per day. An increase of 50 shipments per day would increase the traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 by less than 1 percent. Due to normal variability, the number of material shipments could range from zero to several hundred on some days. This increase in daily traffic would have a small impact from transportation of materials during the construction period of the New Facility Alternative.

The estimates in Table 4.2-1 and the traffic impacts discussed above are conservative. Some materials would arrive by rail. For example, if fly ash is used in concrete, approximately 20 rail cars of fly ash would be received at NRF over the 3-year construction period, replacing approximately 100 truck shipments. Any additional materials that could be transported by rail would minimize the impact of truck shipments to the daily traffic volume. Examples of additional materials that could be shipped by rail include fencing material, firewater tank material, substation material and equipment, concrete formwork, and construction cranes. Excavated materials are expected to remain on NRF property and would not be transported on public roads. Aggregate for lean concrete fill is expected to be obtained from excavated materials stockpiled on NRF property and would not be transported over public roads.

Transportation of Non-Hazardous Waste, RCRA Hazardous Waste, and Recyclable Material

For the construction period of the New Facility Alternative, non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material volumes are described in Section 4.14.3. For RCRA hazardous waste and recyclable materials, the volume in each shipment could increase but would not exceed the capacity of the routine shipment. The baseline data for shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material are provided in Table 3.2-2. There would be no increase from the baseline in the number of shipments of RCRA hazardous waste and recyclable material. During construction, additional non-hazardous waste from siding, roofing, and other activities would be generated. There could be up to five additional shipments of non-hazardous waste per week at a rate of approximately one shipment per day. One additional shipment per day would be a small increase over the baseline number of shipments of non-hazardous waste in Table 3.2-2. Therefore, there would be a negligible impact from transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material during the construction period of the New Facility Alternative.

Transportation of Radiological Waste

There would be no radiological waste shipments during the construction period of the New Facility Alternative since no radiological waste would be generated from construction activity. Therefore, there would be no impact from transportation of radiological waste during the construction period of the New Facility Alternative.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years.

Transportation Infrastructure

No roads or rail lines would be added to support the transition period of the New Facility Alternative; therefore, there would be no impact to transportation infrastructure.

Transportation of Personnel

During the transition period, the number of naval spent nuclear fuel handling workers would increase by approximately 60 due to the overlap in new facility operations with ECF. Approximately 75 percent of NRF employees ride the INL bus; therefore, only 15 additional commuters and a maximum of one additional bus would be expected during the transition period. These 15 commuters and additional bus would have a negligible impact on transportation because traffic volume would increase on U.S. Highway 20, U.S. Highway 26, and State Route 33 by approximately 0.3 percent. There would be no impact to public transportation availability from the transportation of personnel during the transition period of the New Facility Alternative.

Transportation of Materials

There would be no increase in the transportation of materials during the transition period of the New Facility Alternative; the number of material shipments would be expected to remain within the range described in Section 3.2. Therefore, there would be no impact from transportation of materials during the transition period of the New Facility Alternative.

Transportation of Non-Hazardous Waste, RCRA Hazardous Waste, and Recyclable Material

For the transition period of the New Facility Alternative, non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material volumes are described in Section 4.14.3. The volume of non-hazardous waste and recyclable material in each shipment would increase but would not exceed the capacity of the routine shipment. There would be no increase to the annual baseline generation of RCRA hazardous waste for routine work. The baseline data for shipments of non-hazardous waste, RCRA hazardous waste and recyclable material is provided in Table 3.2-2. There would be no increase from the baseline in the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material during the transition period of the New Facility Alternative. Therefore, there would be no impact from transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material during the transition period of the New Facility Alternative.

Transportation of Radiological Waste

Radiological waste transported off-site would be packaged and shipped per DOT regulations by specially trained personnel. For on-site shipments to the RWMC or its replacement, the shipments would meet DOE safety requirements that are equivalent to those for shipments made in accordance with DOT requirements. This equivalency would be accomplished with the use of speed restrictions, escorts, and temporary road closures. There would be no impact from radiation exposures since exposures would be controlled and not exceed those allowed by federal standards.

For the transition period of the New Facility Alternative, radioactive TSCA waste and MLLW would not be generated. Therefore, there would be no impact from transportation of radioactive TSCA waste and MLLW during the transition period of the New Facility Alternative.

During the transition period of the New Facility Alternative, solid LLW in the form of RH LLW and CH LLW would be generated from the naval spent nuclear fuel handling operations as described in Section 4.14.3. RH LLW and CH LLW would exceed the average annual NRF solid LLW generation rate by 20 percent (Section 4.14.3); therefore, the annual number of shipments of solid LLW could increase by approximately eight shipments, or 20 percent. This is considered to be a conservative estimate to cover the uncertainties associated with the volume of waste packed per waste container. The RH LLW would be shipped to the RWMC or its replacement and the CH LLW would be transported off-site. Most solid LLW is CH LLW and would be shipped off-site.

Since there could only be an increase of approximately eight shipments of solid LLW shipments per year, there would be no impact to transportation due to the increase in shipments of solid LLW during the transition period of the New Facility Alternative.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only naval spent nuclear fuel and irradiation test specimen examination work continues in ECF.

Transportation Infrastructure

No roads or rail lines would be added; therefore, there would be no impact to transportation infrastructure during the operational period of the New Facility Alternative.

Transportation of Personnel

Due to efficiencies gained by no longer performing parallel operations, 60 fewer naval spent nuclear fuel handling workers would be required in ECF and the new facility (combined) for the operational period of the New Facility Alternative. As discussed in Section 4.10.3, the decrease in number of workers would be managed through normal attrition. Since 75 percent of NRF employees ride the INL bus, there would be a decrease of about 15 commuters and potentially one less bus during the new facility operational period. This decrease of commuters would create a negligible beneficial impact on transportation because traffic volume would decrease on U.S. Highways 20, U.S. Highway 26, and State Route 33 by approximately 0.3 percent. There would be no impact to availability of public transportation for the operational period of the New Facility Alternative.

Transportation of Materials

There would be no increase in the transportation of materials during the operational period of the New Facility Alternative; the number of material shipments would be expected to remain within the range described in Section 3.2. Therefore, there would be no impact from transportation of materials during the operational period of the New Facility Alternative.

Transportation of Non-Hazardous Waste, RCRA Hazardous Waste, and Recyclable Material

For the new facility operational period, non-hazardous waste, RCRA hazardous waste (including non-radioactive TSCA waste), and recyclable material volumes are described in Section 4.14.3. The volume of non-hazardous waste and recyclable waste in each shipment would decrease. There would be no increase to the annual baseline generation of RCRA hazardous waste for routine work. The baseline data for shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material are provided in Table 3.2-2. There would be no increase from the baseline in the number of shipments of non-hazardous waste, RCRA hazardous waste, and recyclable material during the new facility operational period. Therefore, there would be no impact from transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material during the operational period of the New Facility Alternative.

<u>Transportation of Radiological Waste</u>

Radiological waste transported off-site would be packaged and shipped per DOT regulations by specially trained personnel. For on-site shipments to the RWMC or its replacement, the shipments would meet DOE safety requirements that are equivalent to those for shipments made in accordance with DOT requirements. This equivalency would be accomplished with the use of speed restrictions, escorts, and temporary road closures. There would be no impact from radiation exposures since exposures would be controlled and not exceed those allowed by federal standards.

For the new facility operational period, radioactive TSCA waste and MLLW would not be generated. Therefore, there would be no impact from transportation of radioactive TSCA waste and MLLW during the operational period of the New Facility Alternative.

During the new facility operational period, solid LLW in the form of RH LLW and CH LLW would be generated from naval spent nuclear fuel handling operations as described in Section 4.14.3. RH LLW and CH LLW would exceed the average annual NRF solid LLW generation rate by 20 percent (Section 4.14.3); therefore, the annual number of shipments of solid LLW could increase by approximately eight shipments, or 20 percent. This is considered to be a conservative estimate to cover the uncertainties associated with the volume of waste packed per waste container. The RH LLW would be shipped to the RWMC or its replacement and the CH LLW would be transported off-site. Most solid LLW is CH LLW and would be shipped off-site.

Since there could only be an increase of approximately eight shipments of solid LLW shipments per year, there would be no impact from transportation of solid LLW during the operational period of the New Facility Alternative.

4.3 Geology and Soils

This section discusses the potential impacts to geology and soils from the alternatives. The ROI for geology and soil impact evaluations includes the INL and NRF. There would be no impact to rare or valuable energy sources, minerals, or mining since none are present on INL or NRF. Impacts for geology and soils would occur if the alternatives created a situation where geologic resources were used or soil quality was diminished (e.g., by soil contamination or by erosion and sedimentation).

Impacts to geology and soils on INL would be proportional to the area of land disturbance, the volume of materials removed resulting from refurbishment and construction activities, the use of aggregates for the refurbishment and construction of facilities and supporting infrastructure, and impacts to soil monitoring activities. The area of land disturbed for the alternatives is presented in Section 4.1. The volumes of materials removed and consumed are addressed in Sections 4.3.1, 4.3.2, and 4.3.3.

Section 3.3.3 describes potential geologic hazards. Impacts from geologic hazards apply to all alternatives and could include damage to facilities and the potential for radiological or hazardous material release. Information that applies to the evaluation of more than one alternative is provided below. Public and occupational health and safety impacts from a seismic event are addressed in Section 4.13 and Appendix F.

Volcanic Hazards

As described in Section 3.3.3, volcanism within and outside of the INL boundary includes the possible reoccurrence of silicic volcanism (calderas and explosive volcanism), silicic dome emplacement, basaltic eruptions, and ash falls. The impacts from these hazards are the same for each alternative and are discussed below.

Formation of a silicic caldera at NRF or nearby NRF by explosive rhyolitic volcanism is considered to be extremely unlikely since a large magma body does not exist below the INL. Additionally, the last caldera-forming eruption was over 4.3 million years ago, and the geologic processes that support silicic volcanism have moved northeast 200 kilometers (124 miles) to their current position under the Yellowstone Plateau. The annual probability of a silicic volcano forming near the INL is less than 10^{-6}.

Several small rhyolite domes were emplaced in the vicinity of INL 1.5 million years ago along the main axis of the Eastern Snake River Plain, 27 kilometers (17 miles) south of ECF. Silica dome emplacement would have a probablility of occurrence of less than 10^{-5} annually. Geologic impacts could include ground deformation, magma extrusion, and air-fall ash. The low-water content of the soils does not support explosions from steam buildup.

Basaltic volcanism that produces lava flows would be the most likely volcanic hazard for the INL and NRF because the last eruption of basaltic lava occurred approximately 2000 years ago, and has an average recurrence interval of 2000 years. Lava flows that could affect the site would likely originate from the Axial Volcanic zone (Figure 3.3-1). Basaltic volcanism has a probability of occurrence of less than 10^{-5} annually. Impacts from molten lava could include burning buildings and engulfing structures. An impact from molten lava could adversely affect facility performance; however, basaltic lava flows move very slowly, measured in meters (or feet) per minute, and could be diverted from facilities.

The likelihood of volcanoes located approximately 1000 kilometers (600 miles) to the west in the Cascade Mountain Range (e.g., Mt. Saint Helens) erupting and forming a small ash deposit (1 centimeter (0.4 inches) thick) on INL is 10^{-3} per year. The probability decreases to 10^{-6} per year for an ash deposit that could cause impacts (10 centimeters (4 inches) in thickness. The probability of an ash fall from Yellowstone forming a deposit on INL (less than 10^{-5} occurrences per year) is considered remote, since the prevailing winds are to the east and away from INL and NRF. Ash fall impacts could include: disrupting electricity, transportation, and communications; increasing loads on horizontal surfaces; and hampering air and water filtration systems.

Based on the low probability of occurrence for volcanic hazards, the potential impacts to the alternatives would be negligible. These impacts are not addressed individually for each alternative in Sections 4.3.1, 4.3.2, and 4.3.3.

Seismic Hazards

Numerous studies pertaining to seismic hazards and analysis of facilities to withstand impacts from seismic events have been completed at the INL and NRF. These studies, as discussed in Section 3.3, have evaluated the hazards associated with earthquake ground motion, surface rupture, soil liquefaction, and landslides. Seismic hazards could affect buildings, structures, cranes, water pools, infrastructure systems, and fuel handling equipment. Failure of this infrastructure and equipment could cause a potential hazard to workers, public safety, and the environment due to the potential to release radioactive or hazardous materials into the environment.

DOE establishes performance goals for natural phenomenon hazards (NPH), including seismicity, that could result in severe consequences to facilities and persons. Until 2012, different Performance Category (PC) levels were assigned for structures, systems, and components (SSCs) based upon the consequences of their failure (DOE 2002b). DOE 1993 provides performance categorization guidelines for SSCs, ranging from PC-0 to PC-4, with PC-4 providing the highest level of protection against seismicity for SSCs whose failure could result in the most severe consequences (Table 4.3-1).

In 2012, DOE updated DOE 2002b (DOE 2012b) and transitioned to the use of seismic design category (SDC). For the natural phenomena hazard design of SSCs in nuclear facilities, DOE 2012b uses the radiological hazards evaluation and natural phenomena hazard design categorization process provided in ANS 2004 (Table 4.3-2), supplemented by DOE 2014g and DOE 2008a. Using DOE 2008a, an SDC is assigned to each SSC instead of a PC level based on the potential for radiological release consequences calculated using the process in DOE 2014g (Table 4.3-3). In addition to the change from PC to SDC, DOE 2012b refers to ANS 2004 to assign limit states to SSCs. A limit state (LS) is a description of the extent of damage that an SSC may experience and still perform its intended safety function. ANS 2004 defines four LSs based on the relative amount of permanent distortion the SSC can withstand while still performing its safety function. These LSs are summarized in Table 4.3-4 along with several examples of the types of SSCs for which the defined LS would be appropriate.

The facility design basis is a combination of SDC, LS, and other applicable criteria (specification of codes and standards, load combinations, quality provisions, etc.). A comparison of the DOE PC levels to SDCs is provided in Table 4.3-5.

Table 4.3-1: Definition of Natural Phenomenon Hazard Performance Categories

Performance Category	Performance Goals
0	There are no specific performance goals identified for PC-0 SSCs. Guidance for classifying an SSC as PC-0 is that the SSC is not important because of safety, mission, or cost considerations; and it is more cost effective to replace or repair it than to design it to withstand NPH effects.
1	The performance goal is that the annual probability of SSC damage to the extent that occupants are endangered is $1x10^{-3}$ or less. PC-1 is that the SSC is a building/structure with potential human occupancy, or its failure may cause a fatality, or serious injuries to in-facility workers, or that its failure can be prevented cost-effectively by NPH design.
2	The performance goal is that the annual probability of SSC damage to the extent that component cannot perform its function is $5x10^{-4}$ or less. Guidance for classifying an SSC as PC-2 is that the SSC is not covered by the description for PC-3 or PC-4 SSCs, and if either the SSC failure by itself or with one or more SSCs may result in a loss of function of any emergency handling, hazard recovery, fire suppression, emergency preparedness, communication, or power system that may be needed to preserve the health and safety of workers and visitors.
3	The performance goal is that the annual probability of damage to the extent that the SSCs subject to natural phenomenon hazards cannot perform their function is $1x10^{-4}$ or less. Guidance for the selection of the performance goals and associated annual probability of exceedance for PC-3 and higher SSCs is that they pose a potential hazard to workers, public safety, and the environment because radioactive or hazardous materials are present.
4	The performance goal is that the annual probability of SSC damage to the extent that component cannot perform its function is $1x10^{-5}$ or less. Guidance for classifying an SSC as PC-4 is that the failure of the SSC could result in off-site release consequences greater than or equal to the unmitigated release from a large (>200 megawatts thermal) Category A reactor severe accident that may impair or adversely affect an operator action that is required for safety during and following an NPH event. Further guidance for the selection of the performance goals and associated annual probability of exceedance for PC-4 SSCs is for damage beyond which hazardous materials confinement and safety-related functions are impaired.
Sources: DOE 2002b, DOE 1993	

Table 4.3-2: Definition of Seismic Design Categories

Seismic Design Category	Unmitigated Consequence of SSC Failure		
	Worker	**Public**	**Environment**
1[1]	No radiological/ toxicological release but failure of SSCs may place facility worker at risk of physical injury.	No radiological/ toxicological release consequences.	No radiological/ toxicological release consequences.
2[1]	Radiological/toxicological exposures to workers will have no permanent health effects, may place more facility workers at risk of physical injury, or may place emergency facility operations at risk.	Radiological/toxicological exposures to public areas are small enough to require no public warnings concerned with health effects.	No radiological or chemical environmental consequences.
3	Radiological/toxicological exposures that may place facility workers' long-term health in question.	Radiological/toxicological exposures of public areas would not be expected to cause health consequences but may require emergency plans to assure public protection.	No long-term environmental consequences expected, but environmental monitoring may be required for a period of time.
4	Radiological/toxicological exposures that may cause long-term health problems and possible loss of life for a worker in proximity of the source of hazardous material, or place workers in nearby on-site facilities at risk.	Radiological/toxicological exposures that may cause long-term health problems to an individual at the exclusion area boundary for 2 hours.	Environmental monitoring required and potential temporary exclusion from selected areas for contamination removal.
5	Radiological/toxicological exposures that may cause loss of life of workers in the facility.	Radiological/toxicological exposures that may possibly cause loss of life to an individual at the exclusion area boundary for an exposure of 2 hours.	Environmental monitoring required and potentially permanent exclusion from selected areas of contamination.

[1] "No radiological/toxicological releases" or "no radiological/toxicological consequences" means that material releases that cause health or environmental concerns are not expected to occur from failure of SSCs assigned to this category.

Source: ANS 2004, Table 1

Table 4.3-3: Unmitigated Consequence of SSC Failure From a Seismic Event

Category	Co-located Worker	Public
SDC-1	dose < 5 rem	Not applicable
SDC-2	5 rem < dose < 100 rem	5 rem < dose < 25 rem
SDC-3	100 rem < dose	25 rem < dose

This table, in comparison with criteria in ANS 2004, is truncated at SDC-3 on the following basis.

- No higher designations than safety significant or SDC-3 design requirements are judged to be necessary for collocated worker protection because (in addition to design features) site training and site emergency procedures provide for adequate protection for workers. Only in the case of an in-facility worker who must remain in the facility for safe shutdown or other safety-related purpose should SDC-3 be considered for SSCs required for protection of that worker. In that case, the mitigative effects of personal protective equipment may also be considered. Design effort should give priority to engineered design features over PPE in such a circumstance.
- It is likely that high-hazard, non-reactor nuclear facilities will be built at large sites where it is more likely that the collocated worker criterion would be controlling for seismic design purposes. In such cases, it would be unlikely that the qualitative radiological criteria suggested by ANS 2004 for the public for SDC-4 would be exceeded. If the quantitative public criterion for SDC-3 is exceeded significantly for any project (between one and two orders of magnitude) then the possibility that SDC-4 should be invoked must be considered on a case-by-case basis.

Source: Adapted from DOE 2008a, Table A-1

Table 4.3-4: Definition of Limit States

Limit State	Definition	Examples
A	SSC may sustain large permanent deformation short of collapse and instability (i.e., uncontrolled deformation under minimal incremental load) but shall still perform its safety function and not impact the safety performance of other SSCs.	1. Building structures that must function to permit occupants to escape to safety following an earthquake. 2. Systems and components designed to be pressure retaining but may perform their safety function even after developing some significant leaks following an earthquake.
B	SSC may sustain moderate permanent distortion but shall still perform its safety function. The acceptability of moderate distortion may include consideration of both structural integrity and leak tightness.	1. Building structures that cannot be damaged to the extent that the ability to perform their safety function is lost (fire stations, hospitals, emergency response structures). 2. Systems and components designed to be pressure retaining but may perform their safety function even after developing some minor leaks following an earthquake (i.e., they do not contain hazardous material, or the leakage rates associated with minor leaks do not exceed the consequence level of the assigned SDC).
C	SSC may sustain minor permanent distortion but shall still perform its safety function. An SSC that is expected to sustain minimal damage during and following an earthquake such that no post-earthquake repair is necessary may be assigned to this LS. An SSC in this LS may perform its confinement function during and following and earthquake.	1. Glove boxes containing radioactive or hazardous materials. 2. Confinement barriers for radioactive or hazardous material. 3. HVAC systems that service equipment or building space containing radioactive or hazardous materials. 4. Active components that may have to move or change state following the earthquake.
D	SSC shall maintain its elastic behavior. The SSC shall perform its safety function during and following an earthquake. Gaseous, particulate, and liquid confinement by the SSC is maintained. The component sustains no damage that would reduce its capability to perform its safety function.	1. Containment for large inventories of radioactive or hazardous materials. 2. Components designed to prevent inadvertent nuclear criticality. 3. SSCs that perform safety functions that may be impaired due to permanent deformation (e.g., valve operators, control rod drives, High-Efficiency Particulate Air (HEPA) filter housings, turbine or pump shafts, etc.). 4. SSCs that perform safety functions that require the SSC to remain elastic or rigid so that it retains its original strength and stiffness during and following a design basis event to satisfy its safety, mission, or operational requirements (e.g., relays, switches, valve operators, control rod drives, HEPA filter housings, turbine or pump shafts, etc.).

Source: ANS 2004

Table 4.3-5: Equivalency of Performance and Seismic Design Categories

Seismic Design Category	Performance Category
SDC-1	PC-1
SDC-2	PC-2
SDC-3	PC-3
SDC-4	Not Applicable
SDC-5	PC-4

Impacts from seismic hazards vary for each alternative and are addressed individually for the alternatives in the following sections. The discussions in Sections 4.3.1, 4.3.2, and 4.3.3 use the PC, SDC, and LS terminology as appropriate due to the change in DOE approach.

4.3.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

Excavation, Consumption, and Degradation of Geologic Resources

There are no construction activities associated with the No Action Alternative; therefore, no geologic resources would be consumed or excavated.

Current management practices would be sufficient to limit any contamination of soils from chemical or petroleum leaks or spills. Particulate from the small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations that could be deposited directly onto the ground and carried through the soil to the aquifer are below detectable limits; nonetheless, these ground depositions are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F.

Under the No Action Alternative, if preventative and corrective maintenance are not sufficient to prevent a minor water pool leak, localized on-site soil contamination would occur. Although the potential for a leak could increase, combinations of factors discussed in Appendix F, Section F.5.4.12 minimize the likelihood that a minor water pool leak would result in noticeable off-site environmental impacts. Therefore, under the No Action Alternative, there could be small impacts from soil contamination.

Seismic Hazards

ECF was constructed in phases as described in Chapter 1. Continued maintenance and proper operational management of the facility ensures safe and continued use of the facility that is protective of workers and the public. An updated seismic analysis of the ECF water pool reinforced concrete structures and adjacent building superstructure concluded that the reinforced concrete portion of the pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a PC-3 structure (Table 4.3-1). The analysis verified that the ECF reinforced concrete pools and adjacent building superstructure would maintain structural stability in a design basis earthquake. Additionally, the ECF overhead cranes were determined to remain on the crane rails during a design basis earthquake. Emergency equipment, systems, procedures, and trained emergency response personnel provide measures to mitigate seismic events.

The time period for the No Action Alternative is 45 years, and the facility and supporting infrastructure would continue to degrade over this time period. The majority of the ECF infrastructure is over 40 years old which is the typical design life for a spent nuclear fuel pool facility. In general, maintenance on ECF is performed to meet near-term production demands required to support SA 1995, SAA 2008, and fleet needs rather than extending the service life of the infrastructure.

The most recent probabilistic seismic hazard analysis (PSHA) for the INL, which included NRF, was completed in 1996, and recomputed in 2000. The PSHA estimated levels of ground shaking that could be expected from all earthquake sources in the region. In 2011, a sensitivity analyses was performed for NRF and changes to ground motion models were evaluated using available data and currently accepted methods for modeling. Additional sensitivity analysis performed in 2013 for NRF included evaluating fault source impacts to seismic hazard levels by isolating changes in ground motion models and seismic source characterization. The 2013 sensitivity analysis for NRF showed that changes to area source models and site-specific and empirical ground motion models resulted in similar ground motion levels to the 2011 NRF and 2000 INL seismic hazard analyses.

In 2015, a Senior Seismic Hazard Analysis Committee (SSHAC) Level-1 seismic review was conducted on the site (INL 2016). The INL 2016 review validated that the mean hazard curves for the 2011 seismic sensitivity study and the 2000 PSHA are similar. Therefore, if the PSHA were updated in the future, no changes to calculated impacts to ECF would be expected.

Under the No Action Alternative, activities would not be undertaken to extend the service life of the facility, and issues related to an aging facility would not be addressed. Therefore, the impact of a design basis earthquake to ECF without additional refurbishment or upgrades would be moderate because continuing to operate an aging facility could increase the potential seismic hazard to workers, public safety, and the environment from structural damage or the potential release of radioactive or hazardous materials (Section 4.13 and Appendix F).

4.3.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations.

<u>Excavation, Consumption, and Degradation of Geologic Resources</u>

As described in Chapter 2, a new security boundary system would be installed during the refurbishment period of the Overhaul Alternative. Construction activities associated with the new security boundary system would occur for a duration of approximately 1 year. Impacts from clearing land for the new security boundary system construction would be proportional to the land disturbance (Section 4.1). Approximately 13,000 cubic meters (17,000 cubic yards) of gravel and aggregate materials would be required to construct the new security boundary system and to refurbish the water pool. Borrow materials and gravel would most likely be obtained from sources on the INL such as the Monroe and Lincoln Boulevard pits (Figure 3.3-5), or a new gravel pit at NRF. Existing borrow resources are described in Section 3.3.1 and total approximately 4.2 million cubic meters (5.5 million cubic yards) of reserves in these two pits alone. A total of approximately 16,000 cubic meters (21,000 cubic yards) of material would be excavated, including the borrow from the gravel pit and the soil removed for the construction of new security boundary system. The volume of unusable excavated materials from construction activities would be used to backfill an existing gravel pit at NRF. Reusable materials would be stockpiled for later use.

There would be small impacts to geology and soils and borrow and gravel resources resulting from the construction of the new security boundary system during the refurbishment period of the Overhaul Alternative. Small impacts may result from construction activities which could include: compaction of soil, diminished topsoil quantity and quality resulting from stockpiling and erosion, erosion and sedimentation resulting from changes to the terrain, slight changes to topography resulting from grading and backfilling, and the creation of temporary unstable slopes.

Current management practices would be sufficient to limit any soil contamination from chemical or petroleum leaks or spills could occur during the refurbishment period. NRF controls contamination with spill prevention, clean up, and waste management programs. These programs conform to applicable federal and state requirements and some are subject to Environmental Protection Agency (EPA) and state of Idaho compliance inspections. Natural conditions (e.g., aridity, depth to aquifer, thickness of alluvium) would also help ensure that significant contamination migration would not occur before action could be taken.

Small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations and the refurbishment activities (Section 4.6.2.2) could deposit particulates directly onto the ground, which are then carried through the soil to the aquifer. Overall, the emissions during the refurbishment period would be similar to the emissions from ECF shown in Table 3.6-23. These releases are below detectable limits; nonetheless, they are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F.

Localized on-site soil contamination from a water pool leak could result if preventative and corrective maintenance are not sufficient to prevent a minor water pool leak. Although the potential for a leak could increase, combinations of factors discussed in Appendix F, Section F.5.4.12 minimize the likelihood that a water pool leak would result in noticeable off-site environmental impacts. Therefore, there could be small impacts to soils from potential contamination during the refurbishment period of the Overhaul Alternative.

Seismic Hazards

ECF was constructed in phases as described in Chapter 1. Continued maintenance and proper operational management of the facility ensures safe and continued use of the facility that is protective of workers and the public. An updated seismic analysis of the ECF water pool reinforced concrete structures and adjacent building superstructure concluded that the reinforced concrete portion of the pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a PC-3 structure (Table 4.3-1). The analysis verified that the ECF reinforced concrete pools and adjacent building superstructure would maintain structural stability in a design basis earthquake. Additionally, the ECF overhead cranes were determined to remain on the crane rails during a design basis earthquake. Emergency equipment, systems, procedures, and trained emergency response personnel provide measures to mitigate seismic events.

During the refurbishment period, to the extent practicable, infrastructure and equipment would be refurbished or designed to the appropriate natural phenomena hazard category and design basis to improve the building's ability to withstand vibratory ground motions from seismic activity. Until these activities are complete, activities would continue in ECF that could pose a seismic hazard to workers, public safety, and the environment from structural damage or the potential release of radioactive or hazardous materials (Section 4.13 and Appendix F). Since it will take over 30 years to complete the refurbishments and upgrades, the seismic hazards during the refurbishment period would be moderate.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF.

Excavation, Consumption, and Degradation of Geologic Resources

There would be no impact from excavation or consumption of geologic resources during the post-refurbishment operational period.

Soil contamination from chemical or petroleum leaks or spills could occur during the post-refurbishment operational period. NRF controls contamination with spill prevention, cleanup, and waste management programs. These programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Natural conditions (e.g., aridity, depth to aquifer, thickness of alluvium) would also help ensure that significant contamination migration would not occur before action could be taken. Therefore, there would be no impact to soils from potential contamination during the post-refurbishment operational period of the Overhaul Alternative.

Small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations (Section 4.6.2.2) could deposit particulates directly onto the ground, which are then carried through the soil to the aquifer. These are below detectable limits; nonetheless, they are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F. Therefore, post-refurbishment operational period activities would have no impact to soil quality from contamination.

Seismic Hazards

During the refurbishment period, to the extent practicable, infrastructure and equipment would be refurbished or designed to the appropriate natural phenomena hazard category and design basis to improve the building's ability to withstand vibratory ground motions from seismic activity. Therefore, the impacts of a design basis earthquake to the overhauled ECF facility during the post-refurbishment operational period would be small.

4.3.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts from construction activities of the proposed action are presented below in terms of increases to the baseline established in Section 3.3.

Excavation, Consumption, and Degradation of Geologic Resources

Construction associated with a new facility would occur within or adjacent to already developed areas of NRF. Impacts to geology and soils during construction would result from: clearing and grubbing; earthmoving; terrain shaping; leveling; landscaping; use of new or existing gravel pits; building excavations; and construction of all structures including permanent or temporary buildings, construction lay down and staging areas, walkways, parking lots, a new security boundary system, fences, roads, and utilities. Impacts to geology from these activities could include slight changes to topography and natural drainages. There would be impacts from the removal of materials to excavate the footprint of facilities and supporting infrastructure and impacts from the extraction and use of aggregate resources from gravel pits.

Table 4.3-6 provides an estimate of the excavated volumes for a new facility. The amount of excavated material for construction would be slightly smaller for Location 3/4 compared to Location 6 reflecting the difference in land characteristics and infrastructure needs. Volumes of materials to be excavated were calculated based on the approximate footprint of the locations and an excavated depth specified by engineering drawings and assumptions. The land disturbance areas are addressed in Section 4.1.

The volume of unusable excavated soil materials from construction of the New Facility Alternative would be stockpiled near the construction site or used to backfill an existing gravel pit at NRF. Reusable excavated materials from construction activities and new aggregate materials from the gravel pit required for facility construction would be stockpiled within the proposed disturbance areas. The conceptual planning locations are adjacent to the batch plant for Location 3/4 (Figure 4.1-2), and south of the proposed new facility for Location 6 (Figure 4.1-3).

Table 4.3-6: Volume of Excavated Materials for the Construction Period of the New Facility Alternative

Geologic Resource	Excavation Volume			
	Location 3/4		Location 6	
	cubic meters	cubic yards	cubic meters	cubic yards
Soil	219,000	286,000	366,000	479,000
Rock	13,000	17,000	14,000	18,000
Gravel	174,000	228,000	198,000	259,000
Total	406,000	531,000	578,000	756,000

Borrow materials would be required for the construction of a new facility, new lay down and staging areas, new roads, and a new security boundary system (Table 4.3-7). Borrow materials and gravel would most likely be obtained from sources on the INL such as the Monroe and Lincoln Boulevard pits (Figure 3.3-5), or a new gravel pit at NRF. Existing borrow resources are described in Section 3.3.1 and total approximately 4.2 million cubic meters (5.5 million cubic yards) of reserves in these two pits alone. However, if engineering analysis determines that materials for some concrete-related work require different characteristics than the INL materials, some concrete constituents may be obtained from existing pits located off of the INL.

Table 4.3-7: Borrow Material Requirements for the Construction Period of the New Facility Alternative

Location	Volume	
	cubic meters	cubic yards
Location 3/4	160,000	209,000
Location 6	179,000	235,000
Note: Volumes rounded to the nearest 1000.		

Impacts from the consumption of geologic resources are small due to the existing capacities on the INL. Additional small impacts may result to soils from compaction of soil; diminished topsoil quality resulting from stockpiling and erosion; erosion and sedimentation resulting from changes to the terrain, slight changes to topography resulting from grading and backfilling; and the creation of temporary unstable slopes from construction cuts and fills necessary for building the facility and supporting infrastructure.

Soil contamination from chemical or petroleum leaks or spills could occur during the construction period. NRF controls contamination with spill prevention, cleanup, and waste management programs. These programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Natural conditions (e.g., aridity, depth to aquifer, thickness of alluvium) would also help ensure that significant contamination migration would not occur before action could be taken. Therefore, there would be no impact to soil quality from potential contamination during the construction period of the New Facility Alternative.

Excavation and construction activities at Location 3/4 would occur near soil gas monitoring Well 53-1. Soil gas monitoring Well 53-1 monitors an inactive landfill site 8-06-53 that was one of three landfill sites on NRF evaluated under CERCLA as discussed in Section 3.3.2. Inactive landfill site 8-06-53 is located outside the existing security fence in the northeast corner of the developed area of the NRF site and has six soil-gas monitoring wells located around the perimeter. These wells are monitored periodically in accordance with maintenance plans that are approved by the EPA and the Idaho Department of Environmental Quality (IDEQ), and the results of this monitoring are included in annual environmental monitoring reports (BMPC 2014).

Placement of piling would occur within about 10 feet of Well 53-1. Also heavy equipment traffic would occur in close proximity to this well. These construction activities could damage the well. Options being considered include installing protection around the well, relocation of the well to an area sufficiently distant from construction activities, or properly abandoning and removing the well. The NNPP would propose actions for Well 53-1 during the 2016 NRF Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Review with the EPA and IDEQ to ensure that any necessary soil gas monitoring of site 8-06-53 continues as needed. The options being considered are expected to have a negligible impact upon the current monitoring program because adequate soil monitoring of site 8-06-53 would be provided by other wells.

There would be no airborne radiological releases from construction activities since no radiological materials will be handled during construction. However, naval spent nuclear fuel handling activities would occur in ECF and small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations (Section 3.6.6) could deposit particulates directly onto the ground, which are then carried through the soil to the aquifer. These are below detectable limits; nonetheless, they are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F. Therefore, construction period activities would have no impact to soil quality from contamination.

Seismic Hazards

During the construction period of the New Facility Alternative, ECF would continue to age. The potential seismic hazard to workers, public safety, and the environment from structural damage or the potential release of radioactive or hazardous materials of an aging facility could increase with time (Section 4.13 and Appendix F). However, since the construction period is a short time-frame, there would not be significant time for structural degradation; therefore, the impacts of a design basis earthquake to ECF during the construction period would be small.

Seismic hazards are not evaluated for the new facility during the construction period of the New Facility Alternative because the time period is short and no radioactive materials would be present in the new facility during the construction period.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years.

<u>Excavation, Consumption, and Degradation of Geologic Resources</u>

There would be no impact resulting from excavation or consumption of geological resources during the transition period.

Soil contamination from chemical or petroleum leaks or spills could occur during the transition period. NRF controls contamination with spill prevention, clean up, and waste management programs. These programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Natural conditions (e.g., aridity, depth to aquifer, thickness of alluvium) would also help ensure that significant contamination migration would not occur before action could be taken.

Small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations (Section 4.6.2.3) could deposit particulates directly onto the ground, which are then carried through the soil to the aquifer. These releases are below detectable limits; nonetheless, they are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F. Therefore, the transition period would have no impact to soil quality from contamination.

<u>Seismic Hazards</u>

As described in Section 2.3, to keep the ECF infrastructure in safe working order during the transition period, some limited upgrades and refurbishments may be necessary. Since details are not currently available regarding which specific actions will be taken, it is too early to determine whether those actions will mitigate age-related deterioration and its effect on ECF's seismic performance. Therefore, it is conservatively assumed that the upgrades and refurbishments do not significantly affect seismic performance. The impact of a design basis earthquake to ECF without additional refurbishment or upgrades during the transition period would be moderate.

During the transition period, while operations would be occurring in the ECF, operations would also take place in the new facility. To ensure that the new facility remains safe before, during, and after an earthquake, SSCs would be designed to the appropriate natural phenomena hazard category and design basis discussed in Section 4.3 to withstand vibratory ground motions from seismic activity. Additional factors would be applied for defense in depth. These added factors include actions such as designing the water pool concrete structure using SDC-5 seismic spectra and using concrete in lieu of compacted soil to backfill under and around the water pool. The INL 2016 analysis determined that the current seismic response spectra for both SDC-3 and SDC-5 seismic events were bounding, and no additional seismic scaling factors are needed to account for potential future updates to the INL PSHA. Therefore, the impacts from seismic hazards for the new facility during the transition period of the New Facility Alternative would be small.

New Facility Operational Period

The New Facility Operation Period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only examination work continues in ECF.

Excavation, Consumption, and Degradation of Geologic Resources

There would be no impact resulting from excavation or consumption of geological resources during the new facility operational period.

Soil contamination from chemical or petroleum leaks or spills could occur during the new facility operational period. NRF controls contamination with spill prevention, cleanup, and waste management programs. These programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Natural conditions (e.g., aridity, depth to aquifer, thickness of alluvium) would also help ensure that significant contamination migration would not occur before action could be taken.

Small airborne radiological releases resulting from routine naval spent nuclear fuel handling operations (Section 4.6.2.3) could deposit particulates directly onto the ground, which are then carried through the soil to the aquifer. These are below detectable limits; nonetheless, they are accounted for in the routine naval spent nuclear fuel handling operations radiological analysis described in Section 4.13 and Appendix F. Therefore, new facility operational period activities would have no impact to soil quality from contamination.

Seismic Hazards

As described in Section 2.3, to keep the ECF infrastructure in safe working order during the new facility operational period where ECF continues to operate to support examination work, some limited upgrades and refurbishments may be necessary. Since details are not currently available regarding which specific actions will be taken, it is too early to determine whether those actions will mitigate age-related deterioration and its effect on ECF’s seismic performance. Therefore, it is conservatively assumed that the upgrades and refurbishments do not significantly affect seismic performance. The impact of a design basis earthquake to ECF without additional refurbishment or upgrades during the new facility operational period would be moderate.

To ensure that the new facility remains safe before, during, and after an earthquake, SSCs would be designed to the appropriate natural phenomena hazard category and design basis discussed in Section 4.3 to withstand vibratory ground motions from seismic activity. Additional factors would be applied for defense in depth. These added factors include actions such as designing the water pool concrete structure using SDC-5 seismic spectra and using concrete in lieu of compacted soil to backfill under and around the water pool. The INL 2016 analysis determined that the current seismic response spectra for both SDC-3 and SDC-5 seismic events were bounding and no additional seismic scaling factors are needed to account for potential future updates to the INL PSHA. Therefore, the impacts from seismic hazards for the new facility operational period of the New Facility Alternative would be small.

4.4 Water Resources

This section discusses the potential environmental impacts to water resources from the alternatives. The ROI for impacts on water resources includes the NRF Industrial Waste Ditch (IWD) and active sewage lagoons where storm water, industrial wastewater, or sanitary wastewater are discharged, perched water zones and groundwater beneath NRF, and the Snake River Plain Aquifer (SRPA) beneath and downstream of INL. The retired sewage lagoons would not be impacted by the proposed action; therefore, only the active sewage lagoons are considered part of the ROI and addressed in this section.

Water resources would be impacted if actions associated with the alternatives increase the following parameters:

- Constituents in wastewater or storm water (regulated by wastewater reuse permits per Idaho Administrative Procedure Act (IDAPA) 58.01.16 and IDAPA 58.01.17)
- Wastewater or storm water discharge volumes (regulated by wastewater reuse permits per IDAPA 58.01.16 and IDAPA 58.01.17)
- Constituents in groundwater (regulated by 40 C.F.R. § 141 and 40 C.F.R. § 143 (maximum contaminant levels (MCLs)) and IDAPA 58.01.11 (primary/secondary constituent standards))
- Groundwater use (regulated by the Federal Reserved Water Right for INL)

Unless IWD wastewater reuse permit limits, the Federal Reserved Water Right for INL, or water system infrastructure capabilities are exceeded, impacts are considered to be small. Impacts on water resources are assessed for two general categories: water quality and water use. Water quality is evaluated through constituents in and volume of process and sanitary wastewater discharges, constituents in and volume of storm water discharges, and potential for discharges to eventually impact groundwater. Water use is evaluated through workforce, process, and other needs for potable and non-potable water.

Process wastewater is defined for operations as routine (non-hazardous) wastewater discharged to the IWD through non-radioactive drains. For example, routine operations activities or processes that discharge wastewater to the IWD include:

- Cleaning (e.g., cleaning painting equipment, cement finishing tools, floors, carpets, hoses) and maintenance (e.g., equipment repairs and upkeep)
- Concrete work
- Water heater tank flushes
- Fire sprinkler system tests
- Cooling system flushes
- Water softening
- De-ionized (DI) water treatment

Non-hazardous process wastewater from refurbishment or construction activities could include water from equipment washing (New Facility and Overhaul Alternative), and water used for concrete cutting and drilling (Overhaul Alternative).

The following general assumptions and requirements apply to the analysis of impacts on water resources for the alternatives:

- Under routine operations, no radiological liquid effluent would be discharged to land surfaces, surface water, or the SRPA. Current NNPP methods of radioactive liquid collection, process, and reuse would continue.
- No wastewater or storm water would be discharged to the Big Lost River. See Section 3.4.1.4 and Response to Comment Document #31 in Appendix G for discussion.
- No surface water would be used.

Potable water use and sanitary wastewater discharges for the proposed action are estimated from the number of workers that would be expected for the different time periods considered for each alternative (Section 4.10), and from estimates of average daily or annual water use and generation per person. Annual potable water use and sanitary wastewater generation per person are based on NRF data (2005-2009) and the design basis of the active sewage lagoons, respectively. Activities or operations that would use non-potable water are identified for each alternative, and standard calculation methods are used to estimate volume. Potable and non-potable water are added to determine water use impacts.

Process wastewater constituents, storm water constituents, and discharge volumes are based on NRF data (2005-2009) and changes identified for alternatives (e.g., increased discharge volume due to increased impervious surfaces). Impacts to water resources are determined from percent changes compared to the baseline established in Section 3.4, the IWD wastewater reuse permit limits, or the Federal Reserved Water Right for INL, depending on the parameter. Design operating parameters and backup systems for the active sewage lagoons are also considered.

4.4.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While operations in ECF continue, effluent and groundwater monitoring, with annual reporting to IDEQ, would also continue. Most impacts on water resources are expected to continue at the baseline levels described in Section 3.4.

If ECF operations cease, effluent and groundwater monitoring, with annual reporting to IDEQ, would continue. Most impacts on water resources are expected to decrease compared to the baseline levels described in Section 3.4.

As described in Chapter 2, the No Action Alternative would only include performance of preventative and corrective maintenance. Over the next 45 years, this level of effort may not be sufficient to sustain the proper functioning of ECF infrastructure and equipment and may not prevent minor water pool leaks to the environment. Factors described in Appendix F, Section F.5.4.12 will minimize the likelihood that a water pool leak will result in noticeable off-site environmental impacts. Therefore, the resulting impact on groundwater and drinking water from a minor water pool leak would be negligible.

4.4.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations.

Water Quality

Process Wastewater and Storm Water Constituents

Process wastewater is discharged to either the IWD or active sewage lagoons at NRF. The industrial processes expected to generate routine wastewater during the refurbishment period are similar to those used during operations, maintenance, and upgrades in ECF. Refurbishment activities could include equipment washing and water used for concrete saw cutting and drilling. Construction equipment used during the refurbishment period for the new security boundary system could either be taken to the Central Facilities Area (CFA) to be washed in an established maintenance area, or washed at NRF in a temporary wash area that would prevent any greases or oils from contacting the ground surface and migrating to the subsurface. No new constituents compared to those documented in Table 3.4-1 and Table 3.4-3 are expected in routine wastewater discharges through industrial drains in ECF during the refurbishment period.

A wastewater discharge management plan is used at NRF to control constituents discharged to the IWD and active sewage lagoons to protect the environment. Five years of data for the IWD (Table 3.4-1) show that constituent concentrations released in NRF wastewater are consistently below limits contained in the wastewater reuse permit. The current wastewater discharge management practices would continue during the refurbishment period. Constituents and constituent concentrations in the active sewage lagoons are not regulated by permit; however, all design, testing, and operational requirements in IDAPA 58.01.16 are met and approved by the State (Section 3.4.1.3). The active sewage lagoons are lined to contain constituents. Yearly variation in IWD and retired sewage lagoon effluent constituent concentrations in Table 3.4-1 and Table 3.4-3, respectively, is expected to continue during the refurbishment period of the Overhaul Alternative. Therefore, activities that would occur during the refurbishment period of the Overhaul Alternative would not impact effluent constituent concentrations in the IWD or active sewage lagoons.

Most constituents in storm water discharge to the IWD are naturally occurring (e.g., contained in sediment). Man-made sources are limited to salts (e.g., sodium chloride and magnesium chloride) from use of snow melting compounds in the winter and residual oil and grease from asphalt parking lots and roads. For example, the 5-year mean oil and grease concentration in IWD effluent was less than 3.9 milligrams per liter (Table 3.4-1), and total suspended solids were 14.5 milligrams per liter (permit limit = 100 milligrams per liter). Best management practices, such as spill prevention and clean up, limit man-made sources of constituents in storm water. No activities during the refurbishment period would add to or change the constituents in the storm water discharge. Therefore, activities during the refurbishment period would have no impact on storm water constituents discharged to the IWD under the Overhaul Alternative.

Dredging (e.g., removal of sediment and plant material), as required by the wastewater reuse permit, would be performed if sedimentation is such that infiltration is impeded in the IWD (Section 3.4.1.3 for IWD maintenance requirements). Suspended solids in IWD water are kept low by the wastewater discharge management plan, best management practices at construction sites (e.g., silt fencing, hay bales, or rills that catch sediment in runoff areas), and at the effluent control monitoring station where sediment is collected prior to discharge to the ditch. Due to best management practices, dredging is only performed about every 10 years, and is needed mainly due to wind-blown sediments rather than to suspended solids in discharge water. Therefore, storm water discharge would not impact sedimentation and erosion in the IWD and would not impact permit compliance during the refurbishment period of the Overhaul Alternative.

Process Wastewater and Storm Water Discharge Volumes

The areas cleared and compacted for the new security boundary system could contribute to storm water runoff during the refurbishment period. New security boundary system construction would occur primarily in areas where there are no storm water catch basins. In these areas, runoff would flow overland or simply accumulate and evaporate or percolate into the ground. The new security boundary system would be about 14 meters (46 feet) wide once operational, and would produce negligible runoff. No ditches or culverts would be installed to catch runoff. There would be no impact from storm water runoff due to new security boundary system construction during the refurbishment period of the Overhaul Alternative.

NRF baseline discharges (process wastewater and storm water) to the IWD in 2009 totaled 43,190,000 liters (11,410,000 gallons). This is approximately 40 percent of the permitted limit of 113,600,000 liters (30,000,000 gallons) per year (based on the Industrial Reuse Permit Renewal Application for the Naval Reactors Facility pending approval, dated January 26, 2012). The volume of process wastewater discharges to the IWD during the refurbishment period is not expected to change from the NRF baseline. Several maintenance and facility upgrades have been performed in ECF. While the overhaul would be on a larger scale than these previous upgrades, process wastewater discharge volume from ECF would not increase during the refurbishment period.

With the exception of the new security boundary system mentioned above, refurbishment period activities would not include changing surface permeability (e.g., addition of paving or compacting soils) or increasing surface areas of roofs, parking lots, or other structures associated with ECF that could increase storm water runoff and discharge to the IWD. Therefore, annual storm water discharge volume from ECF would not increase during the refurbishment period of the Overhaul Alternative.

Since there would be no changes to discharge volumes, the IWD has sufficient capacity to support activities during the refurbishment period, with a large buffer for additional discharge before the permit limit would be reached. With no increase in discharge volumes to the IWD, seepage of water to the perched water zone located beneath the IWD outfall would not increase. There would be no impact to erosion and sedimentation since there is no increase in discharge volumes to the IWD. There would be no impact from process wastewater or storm water discharge volumes during the refurbishment period of the Overhaul Alternative.

Sanitary Wastewater Constituents

Constituents in sanitary wastewater are not expected to differ during the refurbishment period from the NRF baseline provided in Table 3.4-3. Therefore, activities during the refurbishment period would have no impact on constituent concentrations in the active sewage lagoons. Constituents would be contained by the lined active sewage lagoons and would not impact the environment.

Sanitary Wastewater Discharge Volumes

Annual sanitary wastewater discharges for the refurbishment period are based on the estimated number of refurbishment workers in the ECF (180) and the number of NRF employees (1370), which includes operational workers in the ECF (Section 4.10). The number of ECF operations workers would not increase during the refurbishment period; therefore, sanitary wastewater discharge would increase due only to the refurbishment workforce. Sanitary wastewater generation for the refurbishment period is shown in Table 4.4-1. Nominal operating parameters for the active sewage lagoons are also shown in Table 4.4-1. Addition of sanitary wastewater discharge from the refurbishment workforce would result in an approximately 13 percent increase in discharge to the active sewage lagoons over the NRF baseline. As described in Section 3.4.1.3, the two active sewage lagoons (of equal size) can operate in parallel, in series, or isolated (i.e., one active sewage lagoon at a time). The nominal operating parameters in Table 4.4-1 are based on operation of one active sewage lagoon at a time. Design conservatisms in operating depth and availability of the second active sewage lagoon allow for variation in operating conditions that include wetter than average years and periods when there are more people on-site (up to 1800). The nominal operating parameters discussed here do not represent operational limits for the active sewage lagoons.

The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons. There would be no impact on operations of the active sewage lagoons from the increase in sanitary wastewater discharge during the refurbishment period of the Overhaul Alternative.

Table 4.4-1: Sanitary Wastewater Discharge During the Refurbishment Period of the Overhaul Alternative

Source	**Volume[1]**			
	liters per year	gallons per year	liters per day	gallons per day
Refurbishment Period Increase[2]	5,110,000	1,350,000	20,000	5,400
NRF Baseline	38,800,000	10,250,000	155,000	41,000
Total[3]	43,910,000	11,600,000	175,000	46,400
Active Sewage Lagoons Nominal Operations	45,420,000[4]	12,000,000[4]	182,000[5]	48,000[5]
Percent Increase[6]	**13.2**			

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Represents the increase in wastewater discharge volume over baseline during the refurbishment period.
[3]Total of Refurbishment Period Increase and NRF Baseline.
[4]Based on nominal operating depth.
[5]Nominal daily flow based on operating design of the active sewage lagoons.
[6]Percent increase in discharge from the refurbishment period compared to NRF Baseline.

Groundwater

Wastewater and storm water discharges to the IWD or to the ground, or uncontrolled spills of chemicals or petroleum products, are potential pathways of groundwater contamination. NRF controls contaminants in these pathways through spill-prevention and clean-up programs, the wastewater discharge management plan, and waste management programs. These plans and programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Examples of best management practices used to protect groundwater include: reducing soil erosion and storm water runoff by using silt fencing, hay bales, or rills that catch sediment, or confine runoff to designated areas (e.g., IWD or infiltration basins); minimizing use of chemicals; and careful management of hazardous materials and wastes.

As discussed in Section 3.4, current NRF operations have a small impact on groundwater quality. Some of the NRF downgradient wells have slightly elevated concentrations of constituents compared to background concentrations. See Section 3.4.2.2 for discussion on current and historic constituent sources and concentrations in NRF groundwater monitoring wells. Over the 33-year refurbishment period as improvements are made, a minor water pool leak to the environment could develop in areas of the pool yet to be refurbished. Factors described in Appendix F, Section F.5.4.12 will minimize the likelihood that a water pool leak will result in noticeable off-site environmental impacts. Therefore, the resulting impact on groundwater from a minor water pool leak would be negligible.

Constituent concentrations in NRF groundwater wells are expected to remain similar to those reported in Table 3.4-6 during the refurbishment period of the Overhaul Alternative. Therefore, activities during the refurbishment period of the Overhaul Alternative would not impact groundwater quality compared to baseline conditions described in Section 3.4.2.2.

Drinking Water

Wellhead and source water protection areas for NRF drinking water wells (NRF-3 and NRF-14) were established in DOE 2003a in accordance with IDEQ 1997 and IDEQ 1999. Sources of contamination for these protection areas include the IWD and the retired sewage lagoons. Protective measures that are in place are progressively more restrictive in areas that are closer to the wellheads. See Section 3.4.2.3 for discussion on NRF wellhead protection areas. The drinking water monitoring program has shown that constituents in drinking water wells are below regulatory limits.

Over the 33-year refurbishment period as improvements are made, a minor water pool leak to the environment could develop in areas of the pool yet to be refurbished. Factors described in Appendix F, Section F.5.4.12 will minimize the likelihood that a water pool leak will result in noticeable off-site environmental impacts. Therefore, the resulting impact on drinking water from a minor water pool leak would be negligible.

<u>Water Use</u>

During the refurbishment period, potable water use would increase from the additional refurbishment workforce of 180 people (Section 4.10). Non-potable water use would increase for activities such as washing equipment and tools, concrete saw cutting, and concrete drilling. Non-potable water use for activities such as landscape maintenance, replacing evaporated water in the water pools, and fire water usage (e.g., drills, testing, and upgrades) would not increase during the refurbishment period. The water pools would need to be drained for refurbishment activities to proceed. The water from the drained water pools would be stored in existing retention basins. The water would be returned to the water pools after refurbishment activities are complete. Since the water pools would be refilled with recycled water (per NNPP methods of radioactive liquid collection and reuse) during the refurbishment period, this is not included as a source of non-potable water use. Additionally, radioactive liquid collection, process, and reuse would continue to provide some of the replacement water needed to offset evaporation from the water pools during operations. This reuse of water is not considered an increase in water use. Estimated increases in annual potable water and non-potable water use during the refurbishment period are provided in Table 4.4-2.

Table 4.4-2: Water Use for the Refurbishment Period of the Overhaul Alternative

Parameter	Volume[1]	
	liters per year	gallons per year
Potable Water Increase	8,440,000	2,230,000
Non-potable Water Increase	58,000	15,000
Total Water Use Increase (potable plus non-potable)	8,498,000	2,245,000
NRF Baseline Water Use[2]	156,260,000	41,280,000
Increase plus NRF Baseline Water Use	164,758,000	43,525,000
INL Water Use in 2009	3,600,000,000	949,000,000
Federal Reserved Water Right for INL	43,000,000,000	11,400,000,000
Percent Increase Over NRF Baseline[3]	**5.4**	
Percent Increase Over INL Baseline[4]	**0.2**	
Percent of Federal Reserved Water Right for INL[5]	**0.4**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Maximum use between 2005 and 2009.
[3]Percent increase from Total Water Use Increase compared to NRF Baseline.
[4]Percent increase from Total Water Use Increase compared to INL Baseline.
[5]Used by NRF during the refurbishment period.

Total water use during the refurbishment period would increase by approximately 5 percent over NRF baseline water use and by 0.2 percent over the INL baseline water use (Table 4.4-2). However, this water use is approximately 0.4 percent of the Federal Reserved Water Right for INL. Therefore, there would be a negligible impact from water use during the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

The post-refurbishment operational period of the Overhaul Alternative addresses the 12 years after refurbishment where only operational activities would take place in ECF.

<u>Water Quality</u>

Process Wastewater and Storm Water Constituents

Process wastewater is discharged to either the IWD or the active sewage lagoons at NRF. A wastewater discharge management plan would continue to be used to control constituents discharged to the IWD and active sewage lagoons. Constituents and constituent concentrations in the active sewage lagoons are not regulated by permit; however, all design, testing, and operational requirements in IDAPA 58.01.16 are met and approved by the State (Section 3.4.1.3). The active sewage lagoons are lined to contain constituents. The industrial processes expected to generate routine wastewater during the post-refurbishment operational period are similar to those used during operations in ECF. No new constituents compared to those documented in Table 3.4-1 and Table 3.4-3 would be expected in routine wastewater discharges from ECF. Therefore, activities that would occur during the post-refurbishment operational period of the Overhaul Alternative would not impact effluent constituent concentrations in the IWD or the active sewage lagoons.

Most constituents in storm water discharge to the IWD are naturally occurring (e.g., contained in sediment). Man-made sources are limited to salts (e.g., sodium chloride and magnesium chloride) from use of snow melting compounds in the winter and residual oil and grease from asphalt parking lots and roads. No activities during the post-refurbishment operational period have been identified that would add to or change the constituents in the storm water discharge. Therefore, activities during the post-refurbishment operational period would have no impact on storm water constituents discharged to the IWD under the Overhaul Alternative.

Dredging (e.g., removal of sediment and plant material), as required by the wastewater reuse permit, would be performed if sedimentation is such that infiltration is impeded in the IWD (Section 3.4.1.3 for IWD maintenance requirements). Suspended solids in IWD water are kept low by the wastewater discharge management plan and at the effluent control monitoring station where sediment is collected prior to discharge to the ditch. Due to best management practices, dredging is only performed about every 10 years, and is mainly needed due to wind-blown sediments rather than to suspended solids in discharge water. Therefore, storm water discharge would not impact sedimentation and erosion in the IWD and would not impact permit compliance during the post-refurbishment operational period of the Overhaul Alternative.

Process Wastewater and Storm Water Discharge Volumes

The new security boundary system would be about 14 meters (46 feet) wide once operational, and would produce negligible runoff. No ditches or culverts would be installed to catch runoff. There would be no impact from storm water runoff due to the new security boundary system during the post-refurbishment operational period of the Overhaul Alternative.

NRF baseline discharges (process wastewater and storm water) to the IWD in 2009 totaled 43,190,000 liters (11,410,000 gallons). This is approximately 40 percent of the permitted limit of 113,560,000 liters (30,000,000 gallons) per year (based on the Industrial Reuse Permit Renewal Application for the Naval Reactors Facility pending approval, dated January 26, 2012). The volume of process wastewater discharges to the IWD during the post-refurbishment operational period is not expected to change from the NRF baseline.

With the exception of the new security boundary system, post-refurbishment operational period activities would not include changing surface permeability (e.g., addition of paving or compacting soils) or increasing surface areas of roofs, parking lots, or other structures associated with ECF that could increase storm water runoff and discharge to the IWD. Therefore, annual storm water discharge volume from ECF would not increase during the post-refurbishment operational period of the Overhaul Alternative.

Since there would be no changes to discharge volumes, the IWD has sufficient capacity to support activities during the post-refurbishment operational period, with a large buffer for additional discharge before the permit limit would be reached. With no increase in discharge volumes to the IWD, seepage of water to the perched water zone located beneath the IWD outfall would not increase. There would be no impact to erosion and sedimentation since there is no increase in discharge volumes to the IWD. There would be no impact from process wastewater or storm water discharge volumes during the post-refurbishment operational period of the Overhaul Alternative.

Sanitary Wastewater Constituents

Constituents in sanitary wastewater are not expected to differ during the post-refurbishment period from the NRF baseline provided in Table 3.4-3. Therefore, activities during the post-refurbishment period would have no impact on constituent concentrations in the effluent of the active sewage lagoons. Constituents in effluent would be contained by the lined active sewage lagoons and would not impact the environment.

Sanitary Wastewater Discharge Volumes

Annual sanitary wastewater discharges for the post-refurbishment period are based on the estimated number of additional workers for the period (50) and the number of NRF employees (1370), which includes the current number of naval spent nuclear fuel handling workers in the ECF (Section 4.10). Sanitary wastewater generation for the post-refurbishment period is shown in Table 4.4-3. Nominal operating parameters for the active sewage lagoons are also shown in Table 4.4-3. Addition of sanitary wastewater discharge from the 50 additional workers would result in an approximately 4 percent increase in discharge to the active sewage lagoons over the NRF baseline. As described in Section 3.4.1.3, the two active sewage lagoons (of equal size) are lined and are designed to operate in parallel, in series, or isolated (i.e., one active sewage lagoon at a time). The nominal operating parameters in Table 4.4-3 are based on operation of one active sewage lagoon at a time. Design conservatisms in operating depth and availability of the second active sewage lagoon allow for variation in operating conditions that include wetter than average years and periods when there are more people on-site (up to 1800). The nominal operating parameters discussed here do not represent operational limits for the active sewage lagoons.

The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons. There would be no impact on operations of the active sewage lagoons from the increase in sanitary wastewater discharge during the post-refurbishment operational period of the Overhaul Alternative.

Table 4.4-3: Sanitary Wastewater Discharge for the Post-Refurbishment Operational Period of the Overhaul Alternative

Generation Source	Volume[1]			
	liters per year	gallons per year	liters per day	gallons per day
Post-Refurbishment Increase[2]	1,420,000	375,000	5,700	1500
NRF Baseline	38,800,000	10,250,000	155,000	41,000
Total[3]	40,220,000	10,625,000	160,700	42,500
Active Sewage Lagoon Nominal Operations	45,420,000[4]	12,000,000[4]	182,000[5]	48,000[5]
Percent Increase[6]	**3.7**			

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Represents the increase in wastewater discharge volume over NRF Baseline during the post-refurbishment operational period.
[3]Total of Post-Refurbishment Increase and NRF Baseline.
[4]Based on nominal operation depth.
[5]Nominal daily flow based on operating design of the active sewage lagoon.
[6]Percent increase from Post-Refurbishment Increase compared to NRF Baseline.

Groundwater

Wastewater and storm water discharges to the IWD or to the ground, or uncontrolled spills of chemicals or petroleum products, are potential pathways of groundwater contamination. NRF controls contaminants in these pathways through spill-prevention and clean-up programs, the wastewater discharge management plan, and waste management programs. These plans and programs conform to applicable federal and state requirements, and some are subject to EPA and state of Idaho compliance inspections. Examples of best management practices used to protect groundwater include confining runoff to designated areas (e.g., IWD or infiltration basins), minimizing use of chemicals, and careful management of hazardous materials and wastes.

As discussed in Section 3.4, current NRF operations have a small impact on groundwater quality. Some of the NRF downgradient wells have slightly elevated concentrations of constituents compared to background concentrations. See Section 3.4.2.2 for discussion on current and historic constituent sources and concentrations in NRF groundwater monitoring wells. Constituent concentrations in NRF groundwater wells are expected to remain similar to those reported in Table 3.4-6 during the post-refurbishment operational period of the Overhaul Alternative. Therefore, activities during the post-refurbishment operational period of the Overhaul Alternative would have no impact on groundwater.

Drinking Water

Wellhead and source water protection areas for NRF drinking water wells (NRF-3 and NRF-14) were established in DOE 2003a in accordance with IDEQ 1997 and IDEQ 1999. Sources of contamination for these protection areas include the IWD and the retired sewage lagoons. Protective measures that are in place are progressively more restrictive in areas that are closer to the wellheads. Section 3.4.2.3 provides a discussion of NRF wellhead protection areas. The drinking water monitoring program has shown that constituents in drinking water wells are below regulatory limits. As discussed above for groundwater, activities during the post-refurbishment period of the Overhaul Alternative would not impact the wellhead protection areas compared to baseline conditions described in Section 3.4.2.3.

<u>Water Use</u>

During the post-refurbishment operational period, water use would increase from the additional NRF workforce of 50 personnel (Section 4.10). Non-potable water use for activities such as landscape maintenance, replacing evaporated water in the water pool, and fire water use (e.g., drills, testing, and upgrades) would not increase. The practice of radioactive liquid collection, process, and reuse would continue to provide some of the replacement water needed to offset evaporation from the water pools. This reuse of water is not considered an increase in water use. Estimated increases in annual potable water use during the post-refurbishment operational period are provided in Table 4.4-4.

Table 4.4-4: Water Use for the Post-Refurbishment Operational Period of the Overhaul Alternative

Parameter	Volume[1]	
	liters per year	gallons per year
Potable Water Increase	2,350,000	621,000
Non-potable Water Increase	0	0
NRF Baseline Water Use[2]	156,260,000	41,280,000
Increase in Water Use plus NRF Baseline Water Use	158,610,000	41,901,000
INL Water Use in 2009	3,600,000,000	949,000,000
Federal Reserved Water Right for INL	43,000,000,000	11,400,000,000
Percent Increase Over NRF Baseline[3]	**1.5**	
Percent Increase Over INL Baseline[4]	**0.1**	
Percent of Federal Reserved Water Right for INL[5]	**0.4**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Maximum use between 2005 and 2009.
[3]Percent increase from the post-refurbishment operational period compared to NRF Baseline.
[4]Percent increase from the post-refurbishment period compared to INL Baseline.
[5]Use by NRF during the post-refurbishment operational period.

Total water use during the post-refurbishment operational period would increase by approximately 2 percent over NRF baseline water use and by 0.1 percent over INL baseline water use. However, this water use is approximately 0.4 percent of the Federal Reserved Water Right for INL. Therefore, there would be a negligible impact from water use during the post-refurbishment operational period of the Overhaul Alternative.

4.4.3 New Facility Alternative

The New Facility Alternative includes construction at Location 3/4 or Location 6 (Chapter 2). With the exception of storm water management during the transition and operational periods for a new facility, small to no differences in environmental impacts on water resources are expected between Location 3/4 and Location 6. Therefore, with the exception of storm water management during the transition and operational periods, impacts on water resources at Location 3/4 and Location 6 are discussed together.

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts to water resources from construction activities are presented in this section in terms of increases to the baseline described in Section 3.4. Impacts to water resources are expected to vary over the construction period depending on the activity.

<u>Water Quality</u>

Process Wastewater and Storm Water Constituents

Process wastewater during the construction period would be generated from washing equipment. Construction equipment could either be taken to the CFA to be washed in an established maintenance area, or washed at NRF in a temporary wash area that would prevent any greases or oils from contacting the ground surface and migrating to the subsurface. Wastewater from washing equipment would not be discharged to the IWD. Therefore, there would be no process wastewater discharged to the IWD that would change constituent concentrations.

Construction areas that could contribute to storm water runoff include areas cleared and compacted for buildings, the new security boundary system, new rail lines, parking lots, and temporary gravel and paved roadways. The majority of runoff would be expected from paved areas or roofs as they are completed during the construction period.

Specific storm water drainage plans for construction would be finalized in later stages of design. Low impact development techniques would be used to prevent groundwater pollution and keep storm water runoff on the construction site. For example, the construction area would be graded, and local infiltration at the construction site would be used for storm water management prior to establishment of paved areas or roofs. Silt in storm water runoff from construction areas could be captured by silt fencing. Water could be collected in infiltration basins downgradient of the exposed areas to minimize erosion and sedimentation on the surrounding environment once paved or roof areas are established. Storm water in infiltration basins would evaporate or infiltrate the ground surface. Construction storm water would not be discharged to the IWD and there would be no impact to this permitted system. Impacts from erosion and sediment in runoff could occur during the construction period of the New Facility Alternative. Established best management practices would continue to be used to minimize sediment and chemical constituents in storm water runoff.

No activities are expected to add to or change the constituents in the storm water discharge during construction; therefore, there is no impact to storm water quality for the construction period of the New Facility Alternative.

Process Wastewater and Storm Water Discharge Volumes

During the construction period, there would be process wastewater from washing concrete trucks. Concrete residue would be washed from the drums and chutes in a designated wash area where the water would evaporate and temporarily wet the soil subsurface. This water is not expected to infiltrate to the Snake River Plain Aquifer due to the low wash volume and distance to the aquifer at NRF (approximately 115 meters (380 feet)). In addition, no greases or oils are present in the drums or chutes of the mixers, so there would be no reasonable potential for contaminants in the wash area. Other construction equipment would not be washed on-site and therefore, there would be no potential for greases or oils to contact the ground surface and migrate to the subsurface. Wastewater from washing concrete trucks would not be discharged to the IWD.

During the construction period, a leak test would be performed on the water pools. The preferred method for managing water used to leak test the pools is to move it between gated sections of the pool and not discharge the water to the environment. Alternative methods would be to discharge the water from leak testing the pools (up to 18,927,000 liters (5,000,000 gallons)) to the sewage lagoons or to the IWD during the last year of construction. The preferred location for discharge is to the sewage lagoons (shorter distance, high capacity). Discharge to the IWD would be the last choice. This discharge would occur over a short period of time (about six days) but is not expected to exceed the infiltration capacity or the maximum flow distance (1.8 miles) previously recorded for the IWD. The permitted annual discharge rate for the IWD would not be exceeded.

If pool leak test water is routed to the IWD, there would be an increase in discharge volume of approximately 44 percent; however, there would be no impact because at this level, discharges to the IWD would be approximately 55 percent of the IWD annual permit limit (Table 4.4-5). Thus, the permit limit would not be exceeded.

Table 4.4-5: Discharge to the IWD for the Construction Period of the New Facility Alternative

Source	Volume[1]	
	liters per year	gallons per year
Construction Period Increase (leak test water)	18,927,000	5,000,000
NRF Baseline[2]	43,190,000	11,410,000
Total[3]	62,117,000	16,410,000
Wastewater Reuse Permit Discharge Limit[4]	113,600,000	30,000,000
Percent Increase Over the NRF Baseline[5]	**43.8**	
Percent of Discharge Limit[6]	**54.7**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Total volume of discharge to the IWD from all NRF sources (including ECF) for 2009.
[3]Total of Construction Period Increase and NRF Baseline.
[4]Based on the Industrial Reuse Permit Renewal Application for the Naval Reactors Facility pending approval, dated January 26, 2012.
[5]Percent increase from construction period over the NRF Baseline.
[6]Percentage of total discharges for NRF (62,115,000 liters) compared to the wastewater reuse permit discharge limit.

The potential increased water discharge volume from leak testing the pools during the construction period could result in additional seepage of water to the perched water zone at the IWD outfall. When the areal extent of this perched water zone was greatest, annual discharge volume to the IWD was 650,000,000 liters (172,000,000 gallons) and was not regulated by a permit (Figure 3.4-8). A one time increase in flow to the IWD of 18,927,000 liters (5,000,000 gallons) could result in a small, short-term increases in the current areal extent of this perched water zone. During the construction period of the New Facility Alternative, there would be small impacts on the amount of water seeping into the perched water zone at the IWD outfall.

Due to best management practices, sedimentation and erosion in the IWD are not expected to increase during the construction period. If needed, dredging (e.g., removal of sediment and plant material) would be used to maintain infiltration in the IWD. See Section 3.4.1.3 for IWD maintenance requirements. Therefore, during the construction period of the New Facility Alternative, the increase in water volumes associated with the potential discharge to the IWD would have a small impact on sedimentation and erosion in this system.

Based on an assessment of the distance and the topography between the new facility construction areas and the Big Lost River, sinks, and playas; the semiarid conditions at NRF; the porous soil conditions; and other hydrologic factors; it is concluded that no water discharged from the proposed new facility construction sites has a reasonable potential of reaching (or flowing to) the Big Lost River (Response to Comment Document #31 in Appendix G). Construction activities for a new facility would not require a National Pollutant Discharge System (NPDES) General Permit for Storm Water Discharges from Construction Sites (Appendix B.4).

Sanitary Wastewater Constituents

Consistent with past construction projects at NRF, sanitary wastewater from the construction workforce would be handled by portable systems and hauled off-site for disposal in accordance with regulations. Constituents in sanitary wastewater discharges during the construction period would not differ from the baseline established in Table 3.4-3. Constituents and constituent concentrations in the active sewage lagoons are not regulated by permit; however, all design, testing, and operational requirements in IDAPA 58.01.16 are met and approved by the State (Section 3.4.1.3). The active sewage lagoons are lined to contain constituents. Constituent concentrations in active sewage lagoon effluent are expected to range between the minimum and maximum values in Table 3.4-3 for the construction period. Therefore, the construction period of the New Facility Alternative would not impact constituent concentrations in the active sewage lagoon effluent.

Sanitary Wastewater Discharge Volumes

Because portable sanitary systems would be used, sanitary discharge volumes to the active sewage lagoons would not increase.

As discussed above, one of the alternative methods for managing water used to leak test the pools is to discharge this process wastewater (up to 18,925,000 liters (5 million gallons)) to the active sewage lagoons. Although this water is not sanitary wastewater, the volume and properties of the water would be within the design parameters of the active sewage lagoons; therefore, there would be no impact to operation of the active sewage lagoons during the construction period of the New Facility Alternative.

Groundwater

Wastewater and storm water discharges to unlined infiltration basins or to the ground, or uncontrolled spills of chemicals or petroleum products, are potential pathways of groundwater contamination. NRF controls contaminants in these pathways through spill-prevention and clean-up programs, the wastewater discharge management plan, and waste management programs. These plans and programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Examples of best management practices used to protect groundwater include: reducing soil erosion and storm water runoff by using silt fencing, hay bales, or rills that catch sediment, or confine runoff to designated areas (e.g., IWD or infiltration basins); minimizing use of chemicals; and careful management of hazardous materials and wastes.

As discussed in Section 3.4.2.2, current NRF operations have a small impact on groundwater quality. Some of the NRF downgradient wells have slightly elevated concentrations of constituents compared to background concentrations. See Section 3.4.2.2 for discussion on current and historic constituent sources and concentrations in NRF groundwater monitoring wells. Construction activities would generate non-hazardous wastewater that would evaporate or infiltrate the ground surface. Sediment would be removed during infiltration. Constituent concentrations in NRF groundwater wells are expected to remain similar to those reported in Table 3.4-6 during the construction period for the New Facility Alternative. Therefore, activities during the construction period for the New Facility Alternative would not impact groundwater quality compared to baseline conditions described in Section 3.4.2.2.

Drinking Water

Wellhead and source water protection areas for NRF drinking water wells (NRF-3 and NRF-14) were established in DOE 2003a in accordance with IDEQ 1997 and IDEQ 1999. Sources of contamination for these protection areas include the IWD (operational) and the retired sewage lagoons. Protective measures that are in place are progressively more restrictive in areas that are closer to the wellheads. See Section 3.4.2.3 for discussion on NRF wellhead protection areas. The drinking water monitoring program has shown that constituents in drinking water wells are below regulatory limits. As discussed above for groundwater, activities during the construction period of the New Facility Alternative would not impact the wellhead protection areas compared to baseline conditions described in Section 3.4.2.3.

Water Use

During the construction period of the New Facility Alternative, potable water for construction workforce consumption would either be provided by an off-site vendor or would be obtained from existing NRF drinking wells that access the SRPA. The estimated increase in annual potable water consumption during construction is provided in Table 4.4-6.

The majority of the non-potable water used during construction would be for dust control, soil and engineered fill compaction, batch plant concrete, batch plant processes, equipment washing and flushing, landscaping, water pool leak test, and final water pool fill. Water use for different construction activities would peak in different years. For example, water use for dust control would be greatest during the first year when maximum land area would be exposed to erosion, while water use for landscaping would be needed in the final year of construction. The fill of the water pools would take several months to complete. To bound water use in any given construction year, maximum annual use for each activity (including water pool leak test and final water pool fill) is summed for a conservative annual increase (Table 4.4-6). Annual water use when construction activities are being phased in or out would be expected to be much less than the bounding value.

Total annual water use (potable and non-potable) during the construction period is provided in Table 4.4-6. Total annual water use during construction would represent an increase of about 50 percent over the NRF baseline (maximum for 2005-2009) and an increase of about 2 percent over the INL baseline water use.

Table 4.4-6: Water Use for Construction Period of the New Facility Alternative

Parameter	Volume[1]	
	liters per year	gallons per year
Potable Water Increase	19,470,000	5,140,000
Non-potable Water Increase	62,110,000	16,410,000
Total Water Use Increase	81,580,000	21,550,000
NRF Baseline Water Use[2]	156,260,000	41,280,000
Total	237,840,000	62,830,000
INL Baseline Water Use in 2009	3,600,000,000	949,000,000
Federal Reserved Water Right for INL	43,000,000,000	11,400,000,000
Percent Increase Over NRF Baseline[3]	**52.2**	
Percent Increase Over INL Baseline[4]	**2.3**	
Percent of Federal Reserved Water Right for INL[5]	**0.6**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Maximum use between 2005 and 2009 for all of NRF (including ECF).
[3]Percent increase from Total Water Use Increase compared to NRF Baseline.
[4]Percent increase from Total Water Use Increase compared to INL Baseline.
[5]Used by NRF during the construction period.

Construction of a new facility would overlap with ECF operations and other NRF operations. Addition of water use from the construction period to the NRF baseline water use would result in a total water use of approximately 237,840,000 liters (62,830,000 gallons). This water use is approximately 0.6 percent of the Federal Reserved Water Right for INL. Therefore, there would be a negligible impact from water use during the construction period of the New Facility Alternative.

Transition Period

After construction, operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years while naval spent nuclear fuel handling operations are being transitioned from ECF into the new facility. At Location 6, process wastewater and storm water would be discharged to the IWD. At Location 3/4, process wastewater would be discharged to the IWD or to the active sewage lagoons, and storm water would be discharged to lined evaporation ponds.

Water Quality

Process Wastewater and Storm Water Constituents

Process wastewater would be discharged to either the IWD (Location 3/4 and Location 6) or the active sewage lagoons (Location 3/4). A wastewater discharge management plan would continue to be used to control constituents discharged to the IWD and active sewage lagoons. Constituents and constituent concentrations in the active sewage lagoons are not regulated by permit; however, all design, testing, and operational requirements in IDAPA 58.01.16 are met and approved by the State (Section 3.4.1.3). The active sewage lagoons are lined to contain constituents. New facility and ECF processes are evaluated, and no new constituents are identified for routine wastewater discharges to the IWD during the transition period. None of the drains in radiological areas of the new facility would be connected to the industrial drain system. With the exception of non-hazardous salts (discussed below) IWD effluent constituent concentrations from both ECF and the new facility should remain similar to those reported in Table 3.4-1 and Table 3.4-3 (i.e., within the range of minimum and maximum concentrations).

Depending on the frequency of water discharge from water softening and DI water treatment processes from a new facility, increases in total output of non-hazardous salts containing ions of calcium, chloride (water softening only), magnesium, potassium, sodium, and sulfate could occur. The new facility would be designed to limit the discharge of salt containing wastewaters. The wastewater discharge management plan for NRF would be used in a new facility and in ECF to control constituents. Small impacts on non-hazardous salts in IWD water could be expected during the transition period. Effluent and groundwater monitoring, with annual reporting to IDEQ, would continue during the transition period.

Operational activities during the transition period of the New Facility Alternative would be similar to existing operations in the ECF; there would be no change in the constituents in storm water discharges. Therefore, new facility operations in parallel with ECF operations would not impact constituents in storm water. Constituent concentrations would remain similar to baseline conditions. Therefore, there would be no impact to storm water quality from the transition period of the New Facility Alternative.

Dredging (e.g., removal of sediment and plant material), as required by the wastewater reuse permit, would be performed if sedimentation is such that infiltration is impeded in the IWD. See Section 3.4.1.3 for IWD maintenance requirements. Suspended solids in IWD water are kept low by the wastewater discharge management plan and at the effluent control monitoring station where sediment is collected prior to discharge to the ditch. Due to best management practices, dredging is only performed about every 10 years, and is mainly needed due to wind-blown sediments rather than to suspended solids in discharge water. Therefore, discharge to the IWD from Location 6 or Location 3/4 would not impact sedimentation and erosion in the IWD and would not impact permit compliance during the transition period of the New Facility Alternative.

Process Wastewater and Storm Water Discharge Volumes

Volume of process wastewater discharged to the IWD would increase during the transition period due to new facility operations compared to baseline conditions. As described in Section 3.4.1.3, sources of water to the IWD consist primarily of storm water, snowmelt runoff, and wastewater from water softening and de-ionizing processes. During new facility operations, DI replacement water for both the new facility and ECF water pools would be needed due to evaporation. DI water would also be needed for various process operations. The reverse osmosis process used to de-ionize water for use in a new facility would generate a waste stream that is estimated to discharge an additional 246,000 liters (65,000 gallons) per year to the IWD. This volume is not expected to change with location.

Section 438 of the Energy Independence and Security Act (EISA) requires federal developments that exceed 5,000 square feet to maintain or restore pre-development hydrology. The purpose of the act is to reduce water quality problems caused by storm water runoff. To demonstrate compliance with the Act, federal agencies can either manage on-site the total volume of rainfall from the 95th percentile storm or manage on-site the total volume of rainfall based on a site-specific hydrologic analysis. Green infrastructure or low impact development practices are often used to comply with Section 438 of the EISA. Green infrastructure generally refers to systems and practices that use or mimic natural processes of evapotranspiration and infiltration, or that reuse storm water or runoff on the site where it is generated. (EPA 2009a)

The storm water management method for the New Facility Alternative would be to retain on-site the volume of rainfall from the 95th percentile storm. At Location 3/4 a local storm water collection system would be used that discharges water by gravity flow into two lined evaporation ponds located on the north and southeast sides of the new facility (Figure 4.4-1). The ponds would be large enough to accommodate more than 100% of the runoff from a 24-hour, 100-year storm. Runoff from the facility roof, grounds, roads, and sidewalks would be collected by a culvert system and discharged to one of the two storm water evaporation ponds (Figure 4.4-1). The lined ponds would contain the storm water on-site and allow it to eventually evaporate. While the primary purpose of the lined ponds would be to hold storm water until it evaporates, the ponds could also be used as a source for rain water harvesting and reuse.

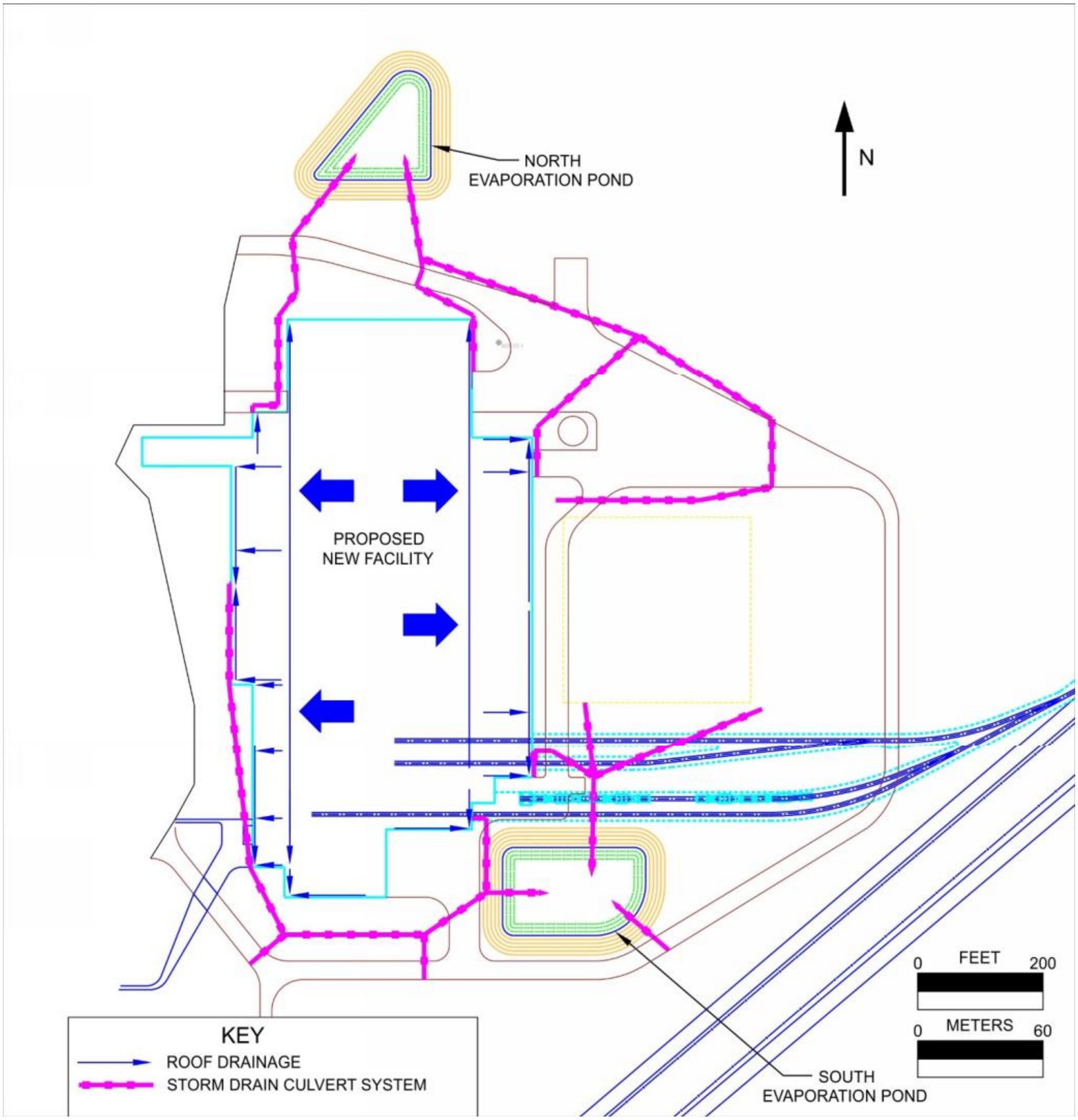


Figure 4.4-1: Storm Water Flow to Lined Evaporation Ponds for Location 3/4

At Location 3/4, the use of lined storm water evaporation ponds would essentially eliminate the discharge of additional storm water from the new facility to the IWD and the associated need for pumping storm water a considerable distance from the source of generation. In addition, this method of storm water management would not increase discharge to the IWD of salts in storm water from use of snow melting compounds in the winter.

For Location 3/4, the volume of storm water runoff from the new facility for the 25-year and 100-year 24-hour storm events was estimated as 2,215,000 liters (585,000 gallons) and 2,847,000 liters

(752,000 gallons), respectively. Based on preliminary design, the combined south and north storm water collection ponds would be able to contain 11,798,000 liters (3,117,000 gallons). Thus, the entire volume of both ponds would accommodate more than 100% of the runoff from the 24-hour, 100-year storm. Therefore, the volume of rainfall from the 95th percentile storm would be retained on-site and there would be no impact on storm water discharge to the IWD. Storm water discharged to the lined ponds would have no potential for reaching the Big Lost River (see Section 3.4 and Response to Comment Document #31 in Appendix G).

Location 6 is in close proximity to the existing storm water line that discharges to the IWD. Therefore, a pump and lift station could be installed (if necessary), and the drainage system for Location 6 would tie-in to the existing storm water line. Storm water would be discharged to the IWD where evapotranspiration and local infiltration would occur. As described in Section 3.4, water discharged to the IWD has no potential for reaching the Big Lost River, and the water is managed on the NRF site. Approval from IDEQ on the storm water system will be required, and applicable regulations contained in IDAPA 58.01.16 and IDAPA 58.01.17 would be followed.

The increase in discharge to the IWD during the transition period from new facility operations (process wastewater for Location 3/4 and process wastewater plus storm water for Location 6) is provided in Table 4.4-7. For Location 3/4 there would be an increase in discharge volume of approximately 0.6 percent over the NRF baseline discharge to the IWD in 2009 (which includes storm water runoff from the ECF). For Location 6 there would be an increase in discharge volume of approximately 35 percent over the NRF baseline discharge to the IWD in 2009. However, there would be no impact at either location because total NRF discharge to the IWD would be within about 38 percent (Location 3/4) and 52 percent (Location 6) of the IWD permit limit. The increased discharge volume from a new facility would not cause NRF to exceed the permit limit during the transition period when both the ECF and new facility are operating.

The increased water discharge volume at Location 3/4 or Location 6 during the transition period could result in additional seepage of water to the perched water zone located beneath the IWD outfall. When the areal extent of this perched water zone was greatest, annual discharge volume to the IWD was 650,000,000 liters (172,000,000 gallons) and was not regulated by a permit (Figure 3.4-8). An increase in flow to the IWD of 15,250,000 liters (4,030,000 gallons) annually at Location 6 (bounding case) could result in a small increase in the current areal extent of this perched water zone. During the transition period of the New Facility Alternative at Location 3/4 or Location 6, there would be small impacts on the amount of water seeping into the perched water zone located beneath the IWD outfall from process wastewater discharge.

Due to best management practices, increases in sedimentation and erosion in the IWD would be small during the transition period. If needed, dredging (e.g., removal of sediment and plant material) would be used to maintain infiltration in the IWD. See Section 3.4 for IWD maintenance requirements. Therefore, during the transition period of the New Facility Alternative at Location 3/4 or Location 6, the increase in discharge volume to the IWD would not impact sedimentation and erosion in this system.

Table 4.4-7: Discharge to the IWD for the Transition Period of the New Facility Alternative

Source	Volume[1]			
	Location 3/4		Location 6	
	liters per year	gallons per year	liters per year	gallons per year
Transition Period Increase (Location 3/4 = new facility process wastewater; Location 6 = new facility process wastewater plus storm water)	246,000	65,000	15,250,000	4,030,000
NRF Baseline[2]	43,190,000	11,410,000	43,190,000	11,410,000
Total[3]	43,436,000	11,475,000	58,440,000	15,440,000
Wastewater Reuse Permit Discharge Limit[4]	113,560,000	30,000,000	113,560,000	30,000,000
Percent Increase[5]	**0.6**		**35.3**	
Percent of Discharge Limit[6]	**38.3**		**51.5**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Total volume of discharges to the IWD in 2009 from all NRF sources (including ECF).
[3] Total of Transition Period Increase and NRF Baseline.
[4]Based on the Industrial Reuse Permit Renewal Application for the Naval Reactors Facility pending approval, dated January 26, 2012.
[5]Percent increase in discharge from the transition period compared to NRF Baseline.
[6]Percent of Total discharges from NRF (with transition period increase) to Wastewater Reuse Permit Discharge Limit.

Sanitary Wastewater Constituents

Constituents and constituent concentrations in sanitary wastewater generated from the ECF and from a new facility during the transition period should remain similar to those for the NRF baseline in Table 3.4-3 (i.e., within the range of minimum and maximum concentrations). Constituents and constituent concentrations in the active sewage lagoons are not regulated by permit; however, all design, testing, and operational requirements in IDAPA 58.01.16 are met and approved by the State (Section 3.4.1.3). The active sewage lagoons are lined to contain constituents. Constituent concentrations in active sewage lagoon effluent are expected to range between the minimum and maximum values in Table 3.4-3 for the transition period. Therefore, the transition period of the New Facility Alternative would not impact constituent concentrations in the active sewage lagoon effluent.

Sanitary Wastewater Discharge Volumes

The total sanitary wastewater discharge estimated for the transition period is provided in Table 4.4-8. The total discharge value includes the new facility, ECF, and other NRF operations, and is based on a workforce of 1415, which includes an increase of 45 workers during the transition period (Section 4.10). As shown, the total annual volume of sanitary wastewater generation during this time period would be an increase of about 2 percent over the NRF baseline (based on workforce of 1370) and would remain within the design operating parameters for the active sewage lagoons (Table 4.4-8). As described in Section 3.4.1.3, the two active sewage lagoons (of equal size) are designed to operate in parallel, in series, or isolated (i.e., one active sewage lagoon at a time). The nominal operating parameters in Table 4.4-8 are based on operation of one active sewage lagoon at a time. Design conservatisms in operating depth and availability of the second active sewage lagoon allow for variation in operating conditions that include wetter than average years and periods when there are more people on-site (up to 1800). The nominal operating parameters discussed here do not represent operational limits for the active sewage lagoons.

Table 4.4-8: Sanitary Wastewater Discharge for the Transition Period of the New Facility Alternative

Source	Volume[1]			
	liters per year	gallons per year	liters per day	gallons per day
Total for New Facility, ECF, and Other NRF Operations[2]	39,750,000	10,500,000	159,000	42,000
NRF Baseline	38,800,000	10,250,000	155,000	41,000
Active Sewage Lagoon Nominal Operations	45,420,000[3]	12,000,000[3]	182,000[4]	48,000[4]
Percent Increase[5]	**2.4**			

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Sum of discharge from ECF, new facility, and other NRF work during the transition period.
[3]Based on nominal operating depth.
[4]Nominal daily flow based on operating design of the active sewage lagoon.
[5]Percent increase in discharge from the transition period compared to NRF Baseline.

The total volume of sanitary wastewater discharged from NRF would be within the design operating parameters of the active sewage lagoons. Based on the increase over baseline during the transition period for a new facility, there would be no impact to active sewage lagoon operations.

Groundwater

Wastewater and storm water discharges to the IWD or to the ground, or uncontrolled spills of chemicals or petroleum products, are potential pathways of groundwater contamination. NRF controls contaminants in these pathways through spill-prevention and clean-up programs, the wastewater discharge management plan, and waste management programs. These plans and programs conform to applicable federal and state requirements and some are subject to EPA and state of Idaho compliance inspections. Examples of best management practices used to protect groundwater include: reducing soil erosion and storm water runoff by using silt fencing, hay bales, or rills that catch sediment, or confine runoff to designated areas (e.g., IWD, lined storm water evaporation ponds, or infiltration basins); minimizing use of chemicals; and careful management of hazardous materials and wastes.

As discussed in Section 3.4, current NRF operations have a small impact on groundwater quality. Some of the NRF downgradient wells have slightly elevated concentrations of constituents compared to background concentrations. See Section 3.4.2.2 for discussion on current and historic constituent sources and concentrations in NRF groundwater monitoring wells. Increased discharges to the IWD during the transition period of the New Facility Alternative would not impact the amount of metals in the SRPA due to best management practices. Potential increases in non-hazardous salts in process wastewater could impact chloride levels in groundwater. Chloride levels are currently above secondary standards in the NRF effluent monitoring well (Table 3.4-6). For these reasons, there could be small impacts to groundwater from the transition period of the New Facility Alternative.

Drinking Water

Wellhead and source water protection areas for NRF drinking water wells (NRF-3 and NRF-14) were established in DOE 2003a in accordance with IDEQ 1997 and IDEQ 1999. Sources of contamination for these protection areas include the IWD (operational) and the retired sewage lagoons. Protective measures that are in place are progressively more restrictive in areas that are closer to the wellheads. See Section 3.4.2.3 for discussion on NRF wellhead protection areas. The drinking water monitoring program has shown that constituents in drinking water wells are below regulatory limits. Activities during the transition period of the New Facility Alternative would not impact the wellhead protection areas compared to baseline conditions described in Section 3.4.2.3

Water Use

During the transition period, potable water use would increase from the additional NRF workforce of 45 people (Section 4.10). Non-potable water use would increase for activities such as landscape maintenance, replacing evaporated water in the water pool, and fire water in the new facility. The practice of radioactive liquid collection, process, and reuse would continue to provide some of the replacement water needed to offset evaporation from the water pools. This reuse of water is not considered an increase in water use. Estimated increases in annual potable and non-potable water use during the transition period are provided in Table 4.4-9.

Table 4.4-9: Water Use for the Transition Period of the New Facility Alternative

Parameter	Volume[1]	
	liters per year	gallons per year
Potable Water Increase	2,110,000	557,000
Non-Potable Water Increase	11,450,000	3,020,000
Total Water Use Increase (potable and non-potable)	13,560,000	3,580,000
NRF Baseline Water Use[2]	156,260,000	41,280,000
Total	169,820,000	44,860,000
INL Baseline Water Use in 2009	3,600,000,000	949,000,000
Federal Reserved Water Right for INL	43,000,000,000	11,400,000,000
Percent Increase Over NRF Baseline[3]	**8.7**	
Percent Increase Over INL Baseline[4]	**0.4**	
Percent of the Federal Reserved Water Right for INL[5]	**0.4**	

[1]Numbers have been rounded; therefore, unit conversions are not exact.
[2]Maximum use between 2005 and 2009.
[3]Percent increase from Total Water Use Increase compared to NRF Baseline.
[4]Percent increase from Total Water Use Increase compared to INL Baseline.
[5]Use by NRF during the transition period.

Total water use would increase by approximately 9 percent over NRF baseline water use and by about 0.4 percent over the INL baseline. However, this water use is approximately 0.4 percent of the Federal Reserved Water Right for INL. Therefore, there would be a negligible impact from water use during the transition period of the New Facility Alternative.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only examination work continues in the ECF. Because the overall amount of work will remain consistent with the work that is performed during the transition period, and there would be no change to the ECF or new facility structures, impacts to process wastewater and storm water constituents and discharges, groundwater, drinking water, and non-potable water use would remain similar to those described for the transition period. Only sanitary wastewater discharge and potable water use would change since these parameters are based on the number of workers. During the new facility operational period, the workforce is expected to decrease by about 110 people (Section 4.10). Therefore, both sanitary wastewater discharges and potable water use would decrease compared to the NRF baseline. There would be no impact on sanitary wastewater discharge, and impacts on water use would remain negligible due to an increase in non-potable water use during the new facility operational period.

4.5 Ecological Resources

This section discusses the potential impacts to ecological resources from the alternatives. The ROI for ecological impacts includes the surrounding INL land area, Federal Class I areas that could be impacted by air pollutants, and those areas which would potentially be disturbed by refurbishment, construction, or operations activities. Direct (e.g., mortality) and indirect (e.g., displacement due to noise) impacts to vegetation and wildlife are assessed and include the following mechanisms:

- Loss or disturbance of vegetation/terrestrial habitat
- Habitat fragmentation creating a barrier to wildlife movement
- Establishment of noxious weeds and non-native species
- Localized death or injury to wildlife
- Noise above levels that could have negative effects on wildlife
- Exposure to radiological releases

Impacts from these mechanisms are assessed according to methods provided below. If no change from baseline conditions established in Section 3.5 is expected, then it is considered that there would be no impact to ecological resources from the proposed action.

For the purposes of the discussions in Section 4.5, 'permanently developed area' refers to an area where infrastructure, buildings, or other permanent structures have been established; 'disturbed area' refers to an area that has been driven on, graded, mowed, or otherwise disturbed, but no permanent structures have been established; and undisturbed communities or habitat are areas that have not been used for NRF activities. The use of permanently developed areas and disturbed areas is consistent with Section 4.1.

Field surveys of vegetation and wildlife of concern (see below) were conducted in potential disturbance areas in 2011 and 2012 (Hafla et al. 2012). A generous buffer zone was used to ensure adequate characterization of the area. Vegetation communities and potential wildlife habitat were characterized by species, cover, and vegetation class. Impacts to vegetation were assessed through percentage of a vegetation class cleared on the INL and of undeveloped NRF land. A relatively low threshold of removal of about 1 percent of a vegetation community on INL or NRF is considered a small impact. Impacts to wildlife are considered small if use in NRF areas is transient, habitat is largely unsuitable, or if activities would be removed from areas where wildlife of concern are shown to be active. Qualitative analyses are presented for potential impacts to wildlife due to noise and habitat fragmentation.

Parameters Evaluated That Pose No Impact to Vegetation or Wildlife

Parameters that were described or analyzed in other sections of this EIS that were determined to have no impact on vegetation and wildlife include:

- Non-radiological air emissions (Section 4.6)
- Constituents in discharges to the active sewage lagoons or IWD that were identified as risk drivers to ecological receptors (Section 3.5 and Section 4.4)

Impacts on vegetation or wildlife from air pollutants were based on whether regulatory standards would be met based on the air quality impacts assessment in Section 4.6.1. Based on initial screening assessments and air pollutant dispersion modeling results, regulatory standards would be met for all criteria, toxic, and Prevention of Significant Deterioration (PSD) pollutants for the proposed action at INL public receptor locations and Federal Class I areas (Craters of the Moon National

Monument, Grand Teton National Park, and Yellowstone National Park). This includes standards for emissions of arsenic, lead, and mercury, which were identified as risk drivers for ecological receptors in the Ecological Risk Assessment conducted for NRF WAG 8 (WEC 1997b). Therefore, there would be no impact on vegetation or wildlife at INL receptor locations or Federal Class I areas due to air emissions.

Several wildlife species are known to use the IWD and the active and retired sewage lagoons. Activities associated with the proposed action would discharge industrial wastewater to the IWD and sanitary wastewater to the active sewage lagoons. While discharge volume would increase for certain periods, concentrations of arsenic, lead, and mercury (ecological risk drivers) in these wastewaters would not change from baseline conditions in Section 3.5 (Section 4.4). Maximum 5-year (2005-2009) concentrations of arsenic, lead, and mercury in IWD and retired sewage lagoon effluent from NRF facilities are provided in Table 3.5-5 and are representative for the proposed action. Concentrations of arsenic, lead, and mercury in aquatic plants and sediment in the IWD are also provided in Table 3.5-5 and would not increase for the proposed action. Therefore, there would be no impact on vegetation or wildlife associated with the IWD or active sewage lagoons. Ecological monitoring under the INL site-wide long-term ecological monitoring plan (Section 3.5.7) would identify any changes to risk for ecological receptors from the proposed action.

INL areas such as the Sagebrush Steppe Ecosystem Reserve, the Long-Term Vegetation Transects, or U.S. Army Corps of Engineers wetlands would not be directly or indirectly impacted by the proposed action. NRF is several kilometers (several miles) away from these sensitive areas.

Vegetation and Wildlife of Concern

Consultation with the United States Fish and Wildlife Service (USFWS) (Appendix B) confirmed that there are no threatened or endangered species (as defined in the Endangered Species Act), or critical habitat for any species, that could be impacted by the proposed action. Additionally, it was determined that habitat conditions at NRF are not likely to support any of the rare or sensitive plant species known to occur on the INL; none were found during surveys conducted in June 2011 (Hafla et al. 2012). Therefore, there is no potential for the proposed action to impact threatened and endangered plants or animals, or rare or sensitive plants.

Wildlife listed as candidate species by the USFWS, or that has been assigned a conservation ranking by the Idaho Conservation Data Center (ICDC) or the State, were evaluated for potential occurrence on the INL based on habitat requirements (Section 3.5.4.1) using site-specific field surveys and literature searches (Hafla et al. 2012 and Section 3.5.4). The wildlife of concern include:

- Greater sage-grouse (*Centrocercus urophasianus*), removed from the candidate species list by the USFWS, protected on the INL by a Candidate Conservation Agreement (CCA).
- Pygmy rabbit (*Brachylagus idahoensis*), listed as imperiled (S2) by the ICDC.
- Migratory birds (including raptors), protected by the Migratory Bird Treaty Act and the USFWS migratory bird take permit for INL.
- Little brown myotis (*Myotis lucifugus*), petitioned for emergency Endangered Species Act listing.
- Large ungulates (e.g., elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), and mule deer (*Odocoileus hemionus*)), Idaho big game animals.

The impacts to these species are discussed for the proposed action in the sections below.

As described in Section 3.5.4.1, DOE and the USFWS cooperatively developed a CCA for the INL that provides for the protection of greater sage-grouse and its habitat while allowing DOE to fulfill its present and future missions (DOE and USFWS 2014). The CCA establishes a Sage-grouse Conservation Area (SGCA) for the INL that limits infrastructure development and human disturbance. In addition, protections are established within a 1-kilometer (0.6-mile) radius (i.e., lek buffer) of all known leks on INL, including those outside of the SGCA. All of the alternatives are located outside of the SGCA, and greater sage-grouse listening surveys performed at NRF in 2011 (Hafla et. al 2012) demonstrated that the facility is not within any of the 1-kilometer (0.6-mile) lek buffers established in the CCA. Therefore, most conservation measures in the CCA would not apply to the proposed action. Best management practices (e.g., re-establishing sagebrush in disturbed areas) established in the CCA for new infrastructure outside the SGCA and outside of existing facility footprints would be followed.

As identified in Section 3.5.2, a bat protection plan is being developed for the INL that will provide for the protection of bat populations and their habitat. Applicable conservation measures identified in this plan would be followed.

Radiological Dose Assessment for Vegetation and Wildlife

A discussion of the impacts to vegetation and wildlife from radiological emissions and potential radiological releases from accidents is provided below. This discussion is provided here because the conclusions of the evaluation are the same for each alternative.

Routine Naval Spent Nuclear Fuel Handling Operations

The impacts to vegetation and wildlife (i.e., biota) were evaluated using a graded approach for routine naval spent nuclear fuel handling operational releases from ECF. This evaluation involved a comparison of expected soil concentrations to biota concentration guides (BCG) from DOE 2002e. Routine naval spent nuclear fuel handling operations radiological releases (Section 4.6.2) from the proposed action would result in soil radionuclide concentrations well below the BCGs with a summed ratio significantly less than 1.0. A BCG ratio less than 1.0 means that the concentration of radioactivity in the biota would not cause the biota dose to exceeded the limits in DOE 2002e. This is the case for all operational time periods analyzed for the No Action Alternative, Overhaul Alternative (post-refurbishment operational period), and the New Facility Alternative (transition period and operational period). These ground contamination levels are shown to have no harmful effect on the terrestrial plant or animal populations based on Level 1 screening using RESRAD-Biota. The RESRAD-Biota computer code is used for analyzing radiological effects on biota. The routine naval spent nuclear fuel handling operations radiological releases from the proposed action would have no impact on vegetation and wildlife.

Hypothetical Accidents

As discussed in Section 4.13, the probability of an accident resulting in a radiological release is small. However, in the event of a radiological accident, mitigation plans for biota would be considered based on the level and extent of contamination in accordance with the graded approach established in DOE 2002e. Factors that would be considered in the decision about whether to prepare a mitigation plan would include:

- The geographical extent of the contamination.
- The magnitude of potential or observed effects of the contamination relative to the level of biological organization affected.

- The likelihood that these effects could occur or will continue to occur.
- The presence of genetically isolated populations.
- The ecological relationship of the affected area to the surrounding habitat.
- The preservation of threatened or endangered species, or commercially or culturally valued species.
- The recovery potential of the affected ecological resources and expected persistence of radionuclides of concern under present site conditions.
- The short-term and long-term effects of the remedial alternatives on the habitat and the surrounding ecosystem.

The mitigation plans would limit the effects to biota. Therefore, there would only be small impacts to wildlife and vegetation from radiological releases in the event of an accident.

4.5.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While operations in the ECF continue, there would not be any associated new construction or increases in operational or human activities. Therefore, the impacts on ecological resources would remain the same as those described for existing activities in Section 3.5. Best management practices in place at NRF would continue to be used to protect wildlife and undeveloped sagebrush communities. Therefore, there would be no impact to ecological resources from the No Action Alternative while operations in ECF continue.

If ECF operations cease, there would not be any associated new construction and therefore no impacts on surrounding plant communities. There would be decreases in operational and human activities, which over time, could result in decreased impacts to wildlife compared to those described for existing activities in Section 3.5. Best management practices in place at NRF would continue to be used to protect wildlife and undeveloped sagebrush communities. Therefore, there is no impact to ecological resources from the No Action Alternative once operations cease.

4.5.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. The additional land development during the refurbishment period is for construction of a new security boundary system. Much of the construction would occur in previously disturbed areas.

<u>Vegetation</u>

Loss or Disturbance of Vegetation

The five plant communities identified in the area surrounding NRF are described in Section 3.5.3. In general, semi-natural plant communities dominated by non-native species have established closer to the NRF perimeter and roads, with relatively undisturbed communities present in areas that are farther from the perimeter. The semi-natural communities were repeatedly disturbed by NRF activities, seeded with aggressive non-native species (e.g., crested wheatgrass) (past practice), and allowed to colonize with other non-native species (e.g., cheatgrass, halogeton (*Halogeton glomeratus*), and tall tumblemustard (*Sisymbrium altissimum*)). These areas have likely passed the threshold of being able to be reclaimed back to native vegetation, but still support wildlife (Section 3.5.3).

There would be temporary and permanent direct impacts on plant communities due to vegetation removal to the north and northwest of NRF from construction of a new security boundary system during the refurbishment period of the Overhaul Alternative (Figure 4.5-1). The area of vegetation that would be disturbed would be approximately 13 hectares (33 acres). This is less than the total land disturbance in Section 4.1, which includes areas with no vegetation. Land clearing and grading for the new security boundary system would occur primarily in previously disturbed areas. Most vegetation clearing would occur in the Big Sagebrush Shrubland and Green Rabbitbrush Winterfat Shrubland community, impacting less than 0.9 percent of this community on INL (Table 4.5-1). Approximately 0.8 percent of total undeveloped land at NRF would be cleared of vegetation. As a best management practice, sagebrush would be re-planted in natural vegetation communities (e.g., the Big Sagebrush Shrubland and Wyoming Big Sagebrush Shrubland communities) that are disturbed during the refurbishment period once they are no longer being used. Therefore, the impacts to plant communities during the refurbishment period of the Overhaul Alternative would be small.

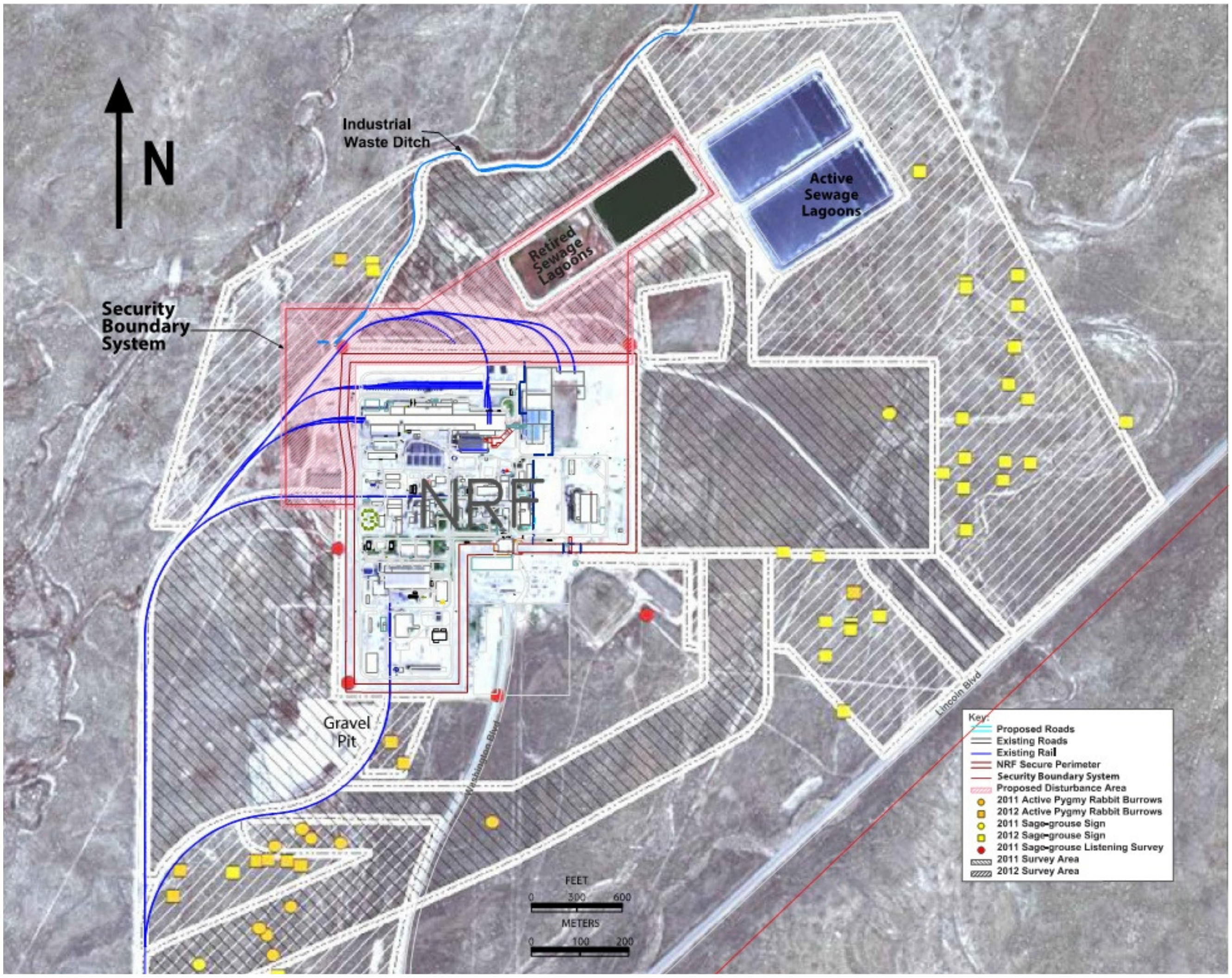


Figure 4.5-1: Disturbance Area and Vegetation and Wildlife Survey Area for the Refurbishment Period of the Overhaul Alternative

Table 4.5-1: Land Disturbance Impacts to Plant Communities From Refurbishment Period of the Overhaul Alternative

Vegetation Community	Area on INL[1]		Area to be Cleared[2]		Percent Disturbed on INL[3]
	hectares	acres	hectares	acres	
Big Sagebrush Shrubland and Cheatgrass Semi-natural Herbacious Vegetation	1500	3735	1	2	0.06
Big Sagebrush Shrubland	47,500	117,365	3	8	0.01
Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbacious Vegetation	2500	6100	2	4	0.06
Big Sagebrush Shrubland and Green Rabbitbrush Winterfat Shrubland	900	2300	8	19	0.85

[1]Source: Shive et. al 2011. The number of acres reported in Shive et al. 2011 are converted to hectares and rounded to the nearest hundred.
[2]Areas are approximate.
[3]Percents are rounded.

Within the four vegetation communities discussed above, 10 species of ethnobotanical importance with documented use among the Shoshone-Bannock Tribes were found at the construction area of the new security boundary system and are described in Section 3.5.3.4. These 10 species are common across the INL (e.g., sagebrush and rabbitbrush), and occur in a variety of vegetation classes. Construction activities such as land clearing and grading would result in destruction of individuals of these species and supporting communities on a local scale. However, the small percentage of INL plant communities that would be impacted by construction of a new security boundary system (Table 4.5-1) would result in only small impacts to individual plants and have little effect on populations of ethnobotanical species as a whole. Therefore, land clearing and grading from construction of the new security boundary system during the refurbishment period would have small impacts on vegetation of ethnobotanical importance on INL.

Best management practices to control storm water runoff and subsequent erosion or sedimentation in plant communities surrounding NRF would continue to be followed during the refurbishment period. Additional storm water runoff would occur during construction of the new security boundary system, but this runoff would evaporate and infiltrate the ground within or near the construction area. No additional increases in storm water runoff would occur from the facility area compared to baseline conditions in Section 3.4.1.4. Therefore, there would be no impact on vegetation from storm water runoff for the refurbishment period.

Noxious Weeds and Non-Native Plants

Land area temporarily disturbed during the refurbishment period from the construction of the new security boundary system would be revegetated with native species, or allowed to naturally reseed, depending on the situation. These efforts would minimize infestations of crested wheatgrass, cheatgrass, and other non-native species and result in a more desirable suite of native species. Guidelines established in the NRF noxious weed control plan and other best management practices (e.g., revegetation with native species) would continue to be used to minimize the spread of non-native plants and noxious weeds. Therefore, impacts of non-native species and noxious weeds during the refurbishment period would be small.

Wildlife

Habitat Loss and Fragmentation

There would be no change in habitat quality during the refurbishment period of the Overhaul Alternative.

Vegetation removal and site grading during construction of the new security boundary system would have direct impacts on wildlife that are present in the area. Larger species (e.g., badger and coyote) and birds would be displaced to nearby suitable habitat, which could result in increased competition for resources in those areas. The new security boundary system would be in place for most of the refurbishment period and would create a barrier to wildlife movement. Because alternate movement routes would be available to wildlife, impacts of habitat fragmentation would be small. Much of the area inside the barrier is either landscaped or unsuitable habitat. Therefore, there would be small impacts to wildlife due to habitat loss from ground disturbance, and from habitat loss inside the new security boundary system, during the refurbishment period of the Overhaul Alternative.

Noise

Noise levels during the refurbishment period would range from 80 to 100 decibels on an A-weighted scale (dBA) outside ECF (Section 4.7). Previous studies on effects of noise on wildlife indicate that even high intermittent noise levels (more than 100 dBA) would not affect wildlife productivity (NRC 2004). Sensitive wildlife receptors avoid current facility noise; however, wildlife in nearby habitats could be disturbed by the increased noise levels during construction of the new security boundary system and could potentially move farther away in the surrounding sagebrush steppe habitat. Once noise returns to pre-construction levels, some species could return to the area. Therefore, temporary increases in noise during the refurbishment period of the Overhaul Alternative would have only small impacts (e.g., area avoidance) on wildlife.

Localized Death or Injury

Although wildlife would likely vacate the area because of noise, land clearing and construction activities associated with the new security boundary system could result in mortality of small mammals, lizards, and snakes that are present in those locations (Section 3.5.4). Larger species (e.g., badger, coyote, and ungulates) and birds are likely to be transient in the disturbance area and would avoid the area. Impacts to wildlife due to localized death or injury would be small.

Most wildlife of potential cultural importance to the Shoshone-Bannock Tribes that could be present in the construction area of the security boundary system (e.g., ungulates, greater sage-grouse, rabbits) would likely avoid the area due to noise and activity (see Wildlife of Concern below). Therefore, impacts from death or injury of these animals would have negligible impacts on wildlife populations that are important to indigenous people.

Wildlife of Concern

During the 2011 greater sage-grouse listening surveys, there was no evidence of displaying greater sage-grouse, indicating no breeding habitat (i.e., leks) present within 1.6 kilometers (1 mile) of NRF (Hafla et al. 2012). During field surveys in 2011 and 2012, several sage-grouse sign were observed primarily on the east and northeast sides of NRF (Figure 4.5-1). These areas are removed from ECF activities and would not be disturbed during the refurbishment period. Two signs of greater sage-grouse were found to the north of the construction footprint for the new security boundary system (Figure 4.5-1). Much of the area inside the new security boundary system is either landscaped or unsuitable habitat for greater sage-grouse. Therefore, there would be negligible impacts to greater sage-grouse from ground disturbance and habitat loss during the refurbishment period of the Overhaul Alternative unless breeding populations moved closer to established facilities. This is considered unlikely because of the current level of noise and activity in these facility areas.

During field surveys for pygmy rabbits, 33 burrows were observed, with 21 of those burrows classified as active (Hafla et al. 2012). One pygmy rabbit was observed. Most of the burrows were found to the southwest of the NRF facility (Figure 4.5-1). The area is removed from ECF activities and from the disturbance area for the construction of the new security boundary system. One active burrow was found to the north of the new security boundary system construction footprint, but this burrow would not be disturbed. Much of the area inside the new security boundary system is either landscaped or unsuitable habitat for pygmy rabbits. Therefore, there would be negligible impacts to pygmy rabbits from ground disturbance and habitat loss during the refurbishment period of the Overhaul Alternative.

Several species of migratory birds are known to occur on NRF property (Section 3.5.4); therefore, they are likely to occur within the construction area of the new security boundary system and would be affected by construction activities. Noise from construction vehicles and equipment could disrupt nesting or foraging activities in the adjacent sagebrush steppe habitat. Initial land clearing (or mowing to eliminate nesting habitat) would be done outside of the nesting period to avoid disruption of active nests. Migratory birds occasionally nest in ECF alcoves and equipment stored outdoors. These behaviors would be expected to continue during the refurbishment period. All provisions of the Migratory Bird Treaty Act and the USFWS migratory bird take permit for INL would continue to be followed during the refurbishment period of the Overhaul Alternative. Avoiding injury to migratory birds or damage to active nests would continue to be a priority. With use of best management practices such as pre-activity surveys for nesting birds and mowing to discourage nesting in the new security boundary system construction areas, activities during the refurbishment period of the Overhaul Alternative would have a negligible impact on migratory birds.

Primary threats to bat populations (including the little brown myotis) on INL have not been established but could include loss of foraging habitat, roosting habitat, and prey base due to activities such as closure of abandoned mines (on lands surrounding INL), alteration of water resources, and pesticide use. Large-scale fires and humans entering and exploring caves have also likely affected bat species on INL. Activities during the refurbishment period of the Overhaul Alternative would not cause changes in water resources or pesticide use at NRF. There are no caves or lava tubes around the ECF or in the area that would be disturbed by construction of the new security boundary system; therefore, roosting habitat would not be lost or fragmented. Bats have been observed roosting in NRF buildings that are not located near the ECF. Construction of the new security boundary system could result in loss of foraging habitat (e.g., sagebrush) and prey base for bats that utilize the sewage lagoons and IWD for a water source. However, much of the area where the new security boundary system would be constructed is already disturbed. Therefore, activities during the refurbishment period would not impact bats at NRF. NRF would continue to support the INL bat monitoring program that was established to learn more about bat populations and bat ecology on INL. In addition, NRF would follow applicable conservation measures established in the bat protection plan once this plan is finalized.

Based on signs of large ungulate use observed during wildlife surveys in 2011 and 2012, large ungulates (primarily pronghorn and mule deer) are transient in the undeveloped NRF area; however, no animals were sighted (Hafla et al. 2012). Large ungulates would likely avoid the construction area for the new security boundary system due to noise and human activity. INL big game surveys conducted from 1989 to 2011 indicate that NRF property is not within annual migration routes or preferred habitat. Therefore, small loss of habitat and the noise and human activity due to construction of the new security boundary system would have negligible impacts to ungulate populations on the INL.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment when only operational activities would take place in the ECF.

<u>Vegetation</u>

Loss or Disturbance of Vegetation

There would be no additional land development during the post-refurbishment operational period for the Overhaul Alternative; therefore, there would be no impact from loss of vegetation due to clearing or grading for the post-refurbishment operational period of the Overhaul Alternative.

Best management practices to control storm water runoff and subsequent erosion or sedimentation in plant communities surrounding NRF would continue to be followed during the post-refurbishment operational period. No increases in storm water runoff would occur compared to baseline conditions provided in Section 3.4.1.4. Therefore, there would be no impact on vegetation from storm water runoff for the post-refurbishment operational period of the Overhaul Alternative.

Noxious Weeds and Non-Native Plants

During the post-refurbishment operational period of the Overhaul Alternative no new areas would be disturbed that could be subject to colonization by noxious weeds or non-native species. Areas under active control would continue to be managed. Guidelines established in the NRF noxious weed control plan and other best management practices (e.g., revegetation with native species) would continue to be used to minimize the spread of non-native plants and noxious weeds. Therefore, there would be no impact to vegetation from non-native species and noxious weeds during the post-refurbishment operational period of the Overhaul Alternative.

<u>Wildlife</u>

Habitat Loss and Fragmentation

No vegetation would be removed, and no change in wildlife habitat quality would occur from activities during the post-refurbishment operational period of the Overhaul Alternative. Therefore, there would be no impact to wildlife from habitat loss.

The new security boundary system would be in place for the overhaul post-refurbishment period and would create a barrier to wildlife movement. Because alternate movement routes would be available to wildlife, impacts of habitat fragmentation would be small. Much of the area inside the new security boundary system is either landscaped or unsuitable habitat. Therefore, there would be small impacts to wildlife from habitat loss during the post-refurbishment operational period of the Overhaul Alternative.

Noise

Noise levels during the post-refurbishment operational period would not change from those established for ECF operations in Section 3.7 and would be largely contained within the ECF. Previous studies on effects of noise on wildlife indicate that even high intermittent noise levels (more than 100 dBA) would not affect wildlife productivity (NRC 2004). Sensitive wildlife receptors avoid current ECF noise. Because there would be no changes in noise levels, there would be no impact to wildlife from noise during the post-refurbishment operational period.

Localized Death or Injury

Wildlife generally avoid the ECF area due to noise. During the post-refurbishment operational period, there would be no additional land clearing or construction activities. Therefore, there would be no localized death or injury impacts to wildlife.

Wildlife of Concern

During the 2011 greater sage-grouse listening surveys, there was no evidence of displaying greater sage-grouse, indicating no breeding habitat (i.e., leks) present within 1.6 kilometers (1 mile) of NRF (Hafla et al. 2012). The areas where greater sage-grouse sign was observed during field surveys (Figure 4.5-1) would not be disturbed during the post-refurbishment operational period. The new security boundary system could block greater sage-grouse movement in the area. However, much of the area inside the new security boundary system is either landscaped or unsuitable habitat for greater sage-grouse. Therefore, there would be negligible impacts to greater sage-grouse from habitat loss during the post-refurbishment operational period of the Overhaul Alternative unless breeding populations moved closer to established facilities. This is unlikely because of the level of noise and activity in these facility areas.

Activities in the ECF that would continue through the post-refurbishment operational period would not disturb the areas where pygmy rabbit burrows were found (Figure 4.5-1). The new security boundary system could block pygmy rabbit movement in the area. However, much of the area inside the new security boundary system is either landscaped or unsuitable habitat for pygmy rabbits. Therefore, there would be negligible impacts to pygmy rabbits from habitat loss during the post-refurbishment operational period of the Overhaul Alternative.

Migratory birds occasionally nest in ECF alcoves and equipment that is stored outdoors. These behaviors would continue during the post-refurbishment operational period. All provisions of the Migratory Bird Treaty Act and the USFWS migratory bird take permit for INL would continue to be followed during the post-refurbishment operational period. Avoiding any injury to migratory birds or damage to active nests would continue to be a priority. Since activities during the post-refurbishment operational period of the Overhaul Alternative would not change from the baseline, there would be no impact on migratory birds.

Primary threats to bat populations (including the little brown myotis) on INL have not been established but could include loss of foraging habitat, roosting habitat, and prey base due to activities such as closure of abandoned mines (on lands surrounding INL), alteration of water resources, and pesticide use. Large-scale fires and humans entering and exploring caves have also likely affected bat species on INL. Activities during the post-refurbishment operational period of the Overhaul Alternative would not cause changes in water resources or pesticide use at NRF. There are no caves or lava tubes around the ECF; therefore, roosting habitat would not be lost or fragmented. Bats have been observed roosting in NRF buildings that are not located near the ECF; these bats would not be impacted by the post-refurbishment operational period of the Overhaul Alternative. NRF would continue to support the INL bat monitoring program that was established to learn more about bat populations and bat ecology on INL. In addition, NRF would follow applicable conservation measures established in the bat protection plan once this plan is finalized.

Based on the number of signs of large ungulate use observed during wildlife surveys in 2011 and 2012, large ungulates (primarily pronghorn and mule deer) are transient in the undeveloped NRF area; however, no animals were sighted (Hafla et al. 2012). Large ungulates would likely avoid the ECF area due to noise and human activity. INL big game surveys conducted from 1989 to 2011 indicate that NRF property is not within annual migration routes or preferred habitat. Since the noise and human activity during post-refurbishment operational period of the Overhaul Alternative would not change from the baseline, there would be no impact to ungulate populations on the INL.

4.5.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts to vegetation and wildlife from new facility construction are in addition to those from the current operation of NRF established in Section 3.5.

Areas around NRF were surveyed for vegetation and wildlife in 2011 and 2012 (Hafla et al. 2012). The surveyed footprints are delineated with respect to temporary disturbance areas for Location 3/4 and Location 6 in Figure 4.5-2 and Figure 4.5-3, respectively. The surveyed areas are larger than the temporary disturbance areas.

Initial construction activities, such as land clearing, would occur over a relatively short period of time, and some impacts to vegetation and wildlife would lessen as construction advances. The majority of vegetation and wildlife habitat would be removed in the disturbance areas.

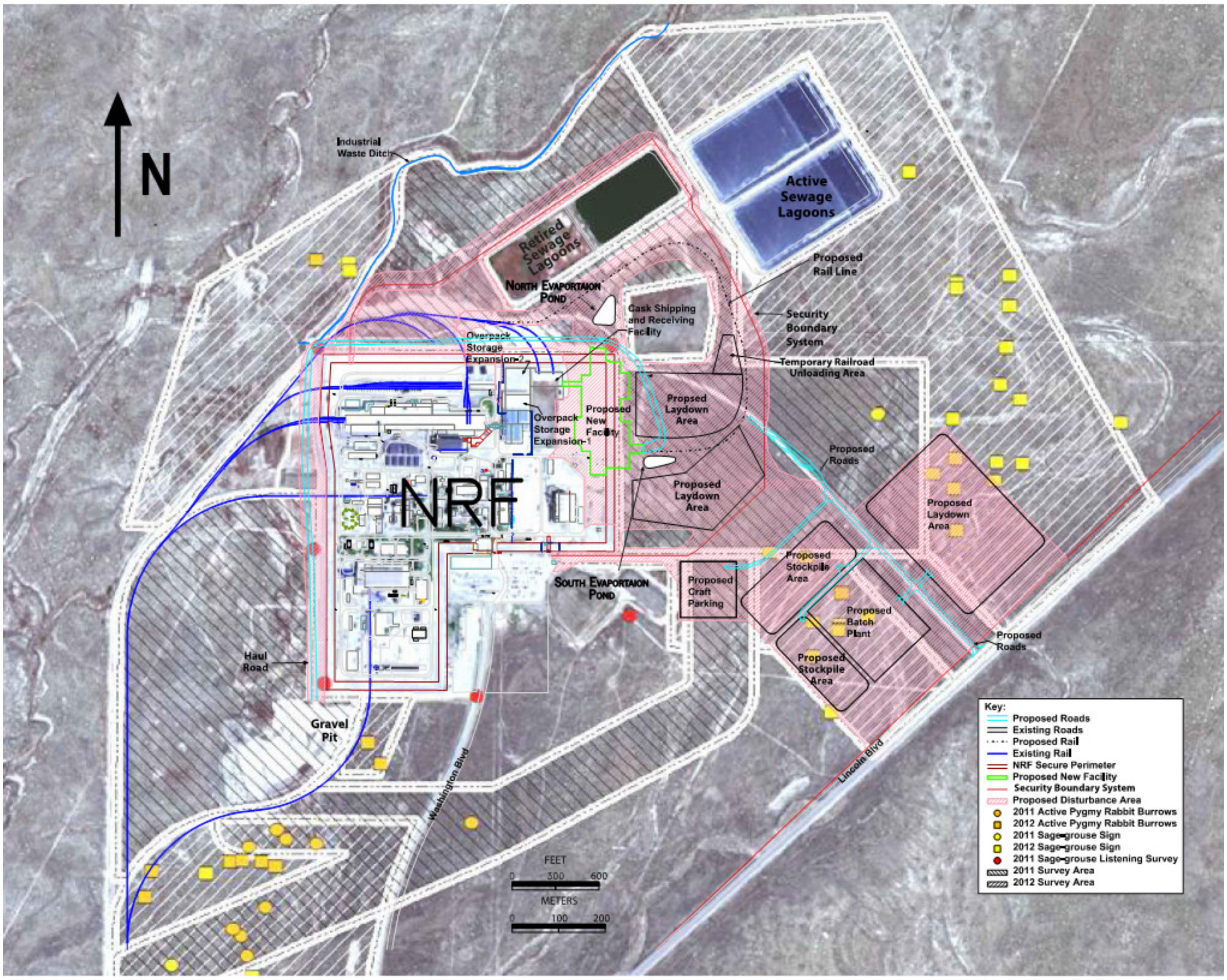


Figure 4.5-2: Disturbance Area and Vegetation and Wildlife Survey Areas for Construction Period of the New Facility Alternative at Location 3/4

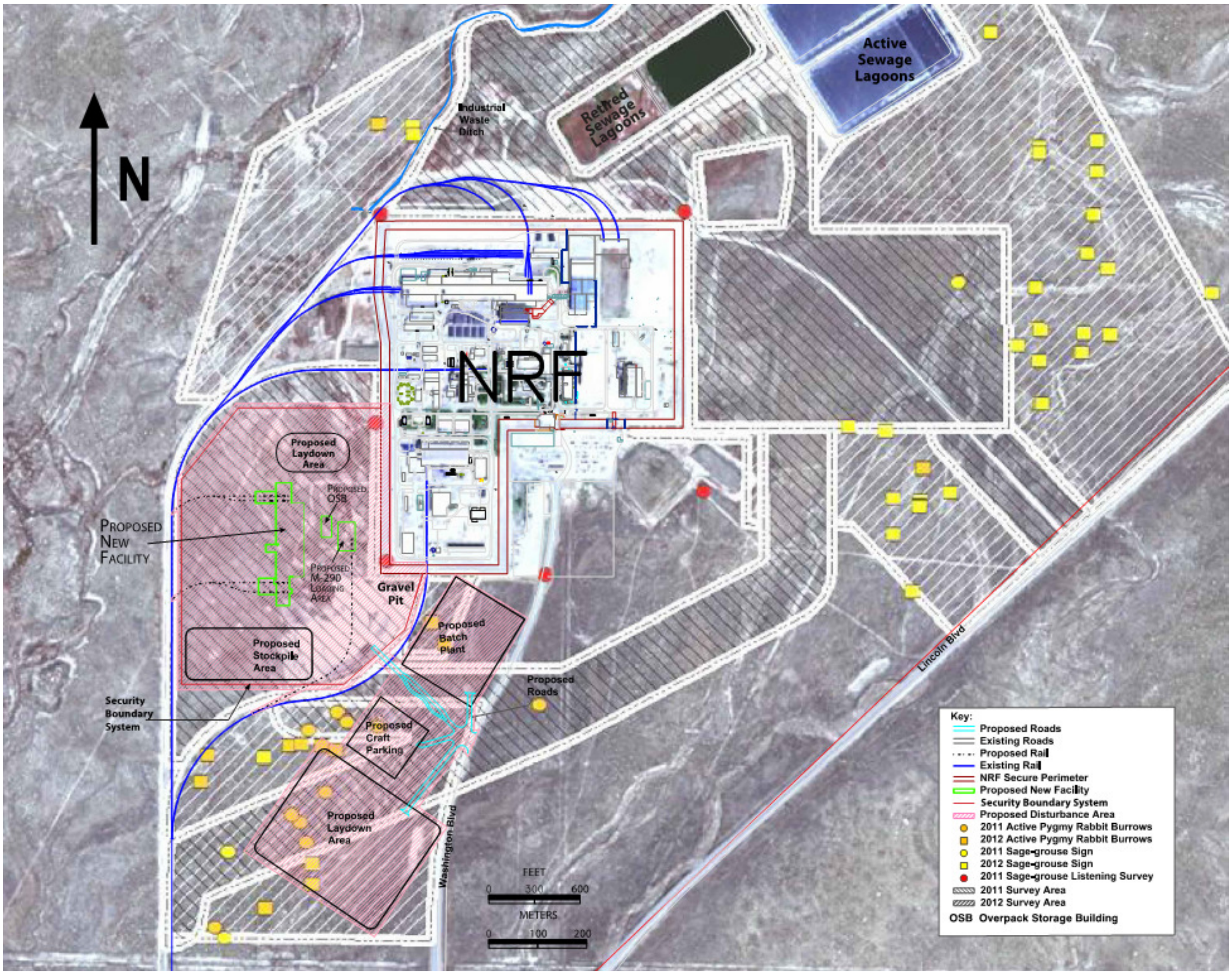


Figure 4.5-3: Disturbance Area and Vegetation and Wildlife Survey Area for Construction Period of the New Facility Alternative at Location 6

<u>Vegetation</u>

Loss or Disturbance of Vegetation

Clearing and grading during construction at Location 3/4 or Location 6 would result in locally intense impacts with complete removal of vegetation. However, when considered in context with the rest of the INL, only a small percentage of plant communities would be destroyed at either location, as discussed below. Up to 55 hectares (136 acres) of land could be disturbed by construction activities at Location 3/4; land disturbance at Location 6 would be smaller (Section 4.1). Both locations have areas that are nearly devoid of vegetation; therefore, these areas are not included in the impact evaluation. This results in a smaller land disturbance area for vegetation impacts than the land disturbance area provided in Section 4.1 where these areas were included. Approximately 16 hectares (40 acres) of the disturbed area at either location would remain as permanently developed for use as facilities and infrastructure.

Table 1 through Table 10 in Hafla et al. 2012 contain a complete list of plant species with measured ground cover for each of the plant communities at Location 3/4 and Location 6. Dominant and important plant species, and general vegetation composition for NRF, are described in Section 3.5.

Approximately 3 percent of total undeveloped land at NRF would be cleared of vegetation at Location 3/4 or Location 6. The majority of vegetation at Location 3/4 that would be directly impacted by removal during construction activities has been largely disturbed by past activities and has re-established in these areas as semi-natural communities. Four plant communities at Location 3/4 would be impacted (Table 4.5-2). There has been less activity in the area of Location 6 compared to Location 3/4. Consequently, vegetation is less disturbed, and the Location 6 area supports both natural and semi-natural vegetation communities (Table 4.5-2). Three plant communities would be impacted at Location 6 (Table 4.5-2).

Table 4.5-2: Land Disturbance Impacts to Plant Communities From Construction Period of the New Facility Alternative

Vegetation Community	Area on INL[1]		Area to be Cleared[2]		Percent Disturbed on INL[3]
	hectares	acres	hectares	acres	
Location 3/4					
Crested Wheatgrass Semi-natural Herbaceous Vegetation	6600	16,382	28	68	0.42
Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation	2500	6100	24	60	1.0
Big Sagebrush Shrubland and Cheatgrass Semi-natural Herbaceous Vegetation	1500	3735	1	3	0.002
Big Sagebrush Shrubland	47,500	117,365	3	8	0.007
Location 6					
Crested Wheatgrass Semi-natural Herbaceous Vegetation	6600	16,382	7	17	0.11
Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation	2500	6100	18	46	0.74
Wyoming Big Sagebrush Shrubland	37,100	91,564	13	31	0.03

[1]Source: Shive et. al 2011. The number of acres reported in Shive et al. 2011 are converted to hectares and rounded to the nearest hundred.
[2]Areas are approximate.
[3]Percents are rounded.

Removal of vegetation at Location 3/4 or Location 6 would result in impacts to relatively small areas of widely distributed plant communities that are common across INL. These impacts would not cause significant loss to any specific community. At Location 3/4, the largest losses would occur in the Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation community, impacting approximately 1 percent of this community on INL (Table 4.5-2). At Location 6, the largest losses would occur in the Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation community, impacting approximately 0.7 percent of this community on INL (Table 4.5-2). As a best management practice, sagebrush would be re-planted in natural vegetation communities (e.g., the Big Sagebrush Shrubland and Wyoming Big Sagebrush Shrubland communities) that are disturbed during construction once they are no longer being used.

Therefore, land clearing and grading at Location 3/4 or Location 6 during the construction period of the New Facility Alternative would have small impacts on vegetation communities on INL.

Within the five vegetation communities discussed above, 10 species of ethnobotanical importance with documented use among Shoshone-Bannock Tribes were found at Location 3/4 and Location 6 and are described in Section 3.5.3.4. These 10 species are common across the INL (e.g., sagebrush and rabbitbrush), and occur in a variety of vegetation classes. Construction activities such as land clearing and grading would result in destruction of individuals of these species and supporting communities on a local scale. However, the small percentage of INL plant communities that would be impacted by the construction period of the New Facility Alternative (Table 4.5-2) would result in only small impacts to individual plants and have little effect on populations of ethnobotanical species as a whole. Therefore, land clearing and grading at Location 3/4 or Location 6 during the construction period of the New Facility Alternative would have small impacts on vegetation of ethnobotanical importance on INL.

Storm water runoff from construction areas could result in soil erosion and sedimentation in adjacent and downgradient plant communities. Loss of soil and buildup of sediments in these communities would reduce plant cover and impact establishment of some species. This could open more space for colonization of non-native species that are better adapted to periodic disturbance. However, both potential construction sites are relatively flat and best management practices (e.g., silt fencing and detention basins downgradient of exposed areas) would be used to minimize impacts on the surrounding environment. Therefore, impacts on undisturbed sagebrush steppe habitat from storm water runoff during the construction period of the New Facility Alternative would be small.

Noxious Weeds and Non-Native Plants

Land area temporarily disturbed during construction at Location 3/4 or Location 6 would be revegetated with native species, or allowed to naturally reseed, depending on the situation. These efforts would minimize infestations of crested wheatgrass, cheatgrass, and other non-native species and result in a more desirable suite of native species. Guidelines established in the NRF noxious weed control plan and other best management practices (e.g., revegetation with native species) would continue to be used to minimize the spread of non-native plants and noxious weeds. Therefore, impacts of non-native species and noxious weeds during the construction period of the New Facility Alternative would be small at Location 3/4 and Location 6.

<u>Wildlife</u>

Habitat Loss and Fragmentation

Vegetation removal and site grading during the construction period of the New Facility Alternative would have direct impacts on wildlife present at Location 3/4 or Location 6. Larger species (e.g., badger, coyote, ungulates) and birds would be displaced to nearby suitable habitat, which could result in increased competition for resources in those areas. The loss of habitat in the lesser disturbed sagebrush communities (e.g., Wyoming Big Sagebrush Shrubland in Location 6) could impact sagebrush obligate species by displacement. Impacts during the construction period of the New Facility Alternative on wildlife from habitat loss would be small at Location 3/4 and Location 6 in comparison to that available on the INL (Table 4.5-2).

Much of the area inside the new security boundary system would be unsuitable habitat due to ongoing construction activity. The new security boundary system would be in place for most of the construction period and would create a barrier to wildlife movement. Because alternate movement routes would be available to wildlife, impacts of habitat fragmentation would be small. There would be small impacts to wildlife from habitat loss in the area of the new security boundary system during the construction period of the New Facility Alternative.

Preservation of undisturbed sagebrush steppe habitat on the INL is important to conservation of many sagebrush-obligate species. Most of the land area that would be cleared for construction at Location 3/4 was previously disturbed, with vegetation that is already modified from natural sagebrush steppe habitat. Location 6 is in a less disturbed area of NRF than Location 3/4. Clearing the localized tracts of land in undisturbed plant communities at Location 3/4 or Location 6 could contribute to habitat fragmentation of the natural communities on NRF. Because alternate movement routes would be available to wildlife, impacts of habitat fragmentation would be small.

Noise

Noise from operation of construction vehicles and equipment would range from 80 to 90 dBA (Section 4.7). Wildlife could be displaced by noise and land disturbance during the construction period at both locations. Because construction would overlap with operations in the ECF, the area of avoidance by wildlife would increase during this period. Once noise returns to pre-construction levels, some species could return to the area. Previous studies on effects of noise on wildlife indicate that even high intermittent noise levels (more than 100 dBA) would not affect wildlife productivity (NRC 2004). For these reasons, noise impacts on wildlife from the construction period of the New Facility Alternative would be small.

Localized Death and Injury

Although wildlife would likely vacate the area because of noise, land clearing and construction activities could result in mortality of small mammals, lizards, and snakes that are present in those locations (Section 3.5.4). Larger species (e.g., badger, coyote, and ungulates) and birds are likely to be transient in the disturbance area and would avoid the area. Impacts to wildlife due to localized death or injury would be small.

Most wildlife of potential cultural importance to the Shoshone-Bannock Tribes that could be present in the new facility construction area (e.g., ungulates, greater sage-grouse, rabbits) would likely avoid the area due to noise and activity (see Wildlife of Concern below). Therefore, impacts from death or injury of these animals would have negligible impacts on populations that are important to indigenous people.

Wildlife of Concern

During the 2011 greater sage-grouse listening surveys, there was no evidence of displaying greater sage-grouse, indicating no breeding habitat (i.e., leks) present within 1.6 kilometers (1 mile) of NRF (Hafla et al. 2012). During field surveys, one sign of greater sage-grouse was found in Location 6, indicating only transient use of this area. Several signs of greater sage-grouse were found in the survey area for Location 3/4 (Figure 4.5-2). Some were found within the temporary disturbance area in Wyoming Big Sagebrush Shrubland and Crested Wheatgrass Semi-natural Herbaceous Vegetation communities. The remaining signs of greater sage-grouse were outside of the temporary disturbance area primarily in the undisturbed Big Sagebrush Shrubland communities. The presence of greater sage-grouse sign within the temporary disturbance area and survey buffer areas for Location 3/4 indicates that this species has used these areas, perhaps as seasonal habitat. The closest known lek to the NRF western boundary is 4.5 kilometers (2.8 miles) to the west. Data collected on greater sage-grouse on the INL indicate that 62 percent of greater sage-grouse nests occur within 5 kilometers (3.1 miles) of leks. However, the habitat in the temporary disturbance area at Location 3/4 is not likely to be suitable for nesting greater sage-grouse for several reasons:

- The location is in close proximity to NRF facilities and a major road.
- The areas near the current NRF perimeter are mostly comprised of plant communities dominated by crested wheatgrass.
- The area of the observed greater sage-grouse sign is 5.5 kilometers (3.4 miles) from the nearest lek.

Therefore, construction at Location 3/4 or Location 6 would have small impacts on INL greater sage-grouse populations. Additionally, the amount of human activity and noise associated with the NRF facility area would tend to discourage greater sage-grouse nesting in the potential disturbance areas.

Thirty-three pygmy rabbit burrow complexes, 21 of which were active, and one pygmy rabbit were found during field surveys. Many were found to the southwest of NRF in the temporary disturbance area for Location 6 (Figure 4.5-3). Most of the remaining burrows were in the survey buffer areas near Location 6, although one burrow was found in the temporary disturbance area for Location 3/4. The temporary disturbance area of Location 3/4 and the area to the north of NRF where the new security boundary area would be constructed have little potential for pygmy rabbit habitat (Hafla et al. 2012). There would be small impacts to pygmy rabbits due to activities during the construction period for the New Facility Alternative. These impacts would likely be greater at Location 6.

Several species of migratory birds are known to occur on NRF property (Section 3.5.4); therefore, they are likely to occur within Location 3/4 or Location 6. Migratory birds would be affected by construction activities. Noise from construction vehicles and equipment could disrupt nesting or foraging activities in adjacent sagebrush steppe habitat. Initial land clearing (or mowing to eliminate nesting habitat) would be done outside of the nesting period to avoid disruption of active nests. All requirements of the Migratory Bird Treaty Act and the USFWS migratory bird take permit for INL would be followed throughout the construction period. The percentage of sagebrush and grassland habitats supporting migratory birds that would be eliminated at Location 3/4 or Location 6 is small compared to total habitat on INL (Table 4.5-2). Therefore, impacts to migratory birds during the construction period of the New Facility Alternative would be small.

The construction period for the New Facility Alternative could result in loss of foraging habitat (e.g., sagebrush) and prey base for bats that utilize the sewage lagoons and IWD for a water source. However, as demonstrated above, this would be a small percentage of sagebrush habitat compared to what is available on INL (Table 4.5-2). Additionally, there are no caves or lava tubes in the potential disturbance areas that would be impacted during construction, and buildings where bats have been observed roosting at NRF are not located near the construction sites. Therefore, new facility construction would have small impacts on bats at NRF due to loss of foraging habitat. NRF would continue to support the INL bat monitoring program that was established to learn more about bat populations and bat ecology on INL. In addition, NRF would follow applicable conservation measures established in the bat protection plan once this plan is finalized. Applicable conservation measures would be incorporated in the Construction Management Plan for a new facility.

Based on signs of large ungulate use observed during wildlife surveys in 2011 and 2012 (Hafla et al. 2012), large ungulates (primarily pronghorn and mule deer) are transient in the undisturbed areas of NRF; however no animals were observed during the surveys. Large ungulates would likely avoid construction areas due to noise and human activity. INL big game surveys conducted from 1989 to 2011 indicate that NRF property is not within annual migration routes or preferred habitat. Therefore, small loss of habitat and the noise and human activity due to construction at Location 3/4 or Location 6 would have only small impacts to ungulate populations on the INL.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for 5 to 12 years.

<u>Vegetation</u>

Loss or Disturbance of Vegetation

There would be no loss of vegetation due to land clearing or grading during the transition period of the New Facility Alternative. Therefore, there would be no impact from loss of vegetation due to clearing and grading for the transition period of the New Facility Alternative.

At Location 6, the existing NRF storm water system would be used (with modification) for a new facility (Section 4.4.3). The existing storm water system routes water to the IWD where it evaporates and infiltrates the ground surface. The increased volume of storm water during the transition period of the New Facility Alternative would likely result in increased flow depth and distance in the IWD. Storm water runoff during the transition period of the New Facility Alternative could have small impacts to vegetation supported by the sides and banks of the IWD through erosion or sedimentation. However, more water available during the growing season would have a positive impact on biomass production. In addition to routing storm water to the IWD, collection and local infiltration would also be considered for selected roof drains or catch basins where the quantity of water is manageable. The collected water could be used locally in environmentally beneficial ways such as in landscape irrigation and result in small positive impacts to vegetation establishment and growth. Any storm water systems would be designed to minimize potential impacts (e.g., erosion and sedimentation) on plant communities adjacent to the new facility. At Location 3/4, the use of lined storm water evaporation ponds would essentially eliminate the discharge of additional storm water from the new facility to the IWD or surrounding environment. Therefore, storm water runoff impacts of erosion and sedimentation on vegetation during the transition period of the New Facility Alternative would be small.

Noxious Weeds and Non-Native Plants

During the transition period of the New Facility Alternative no new areas would be disturbed that could be subject to colonization by noxious weeds or non-native species. Areas under active control would continue to be managed. Guidelines established in the NRF noxious weed control plan and other best management practices (e.g., revegetation with native species) would continue to be used to minimize the spread of non-native plants and noxious weeds. Therefore, there would be no impact to vegetation from non-native species and noxious weeds during the transition period of the New Facility Alternative.

<u>Wildlife</u>

Habitat Loss and Fragmentation

No vegetation would be removed, and no change in wildlife habitat quality would occur from activities during the transition period of the New Facility Alternative.

The new facility structures would create barriers to wildlife movement and permanent loss of habitat. The new security boundary system would be in place for the transition period and would create a barrier to wildlife movement. However, much of the area inside the barrier would either be landscaped or unsuitable habitat. Because alternate movement routes would be available to wildlife, impacts of habitat fragmentation would be small during the transition period of the New Facility Alternative. There would be small impacts to wildlife from habitat loss during the transition period of the New Facility Alternative

Noise

Noise levels from operations of a new facility would be similar to those from current operations in ECF and would not exceed those recorded levels at NRF described in Section 3.7. During the transition period, noise impacts would be extended over a greater area of wildlife habitat (e.g., combined habitat around ECF and a new facility), which could result in a greater area that would be avoided by wildlife. Noise impacts on wildlife would be small during the transition period at either NRF location.

Localized Death or Injury

Wildlife would generally avoid the ECF and new facility areas due to noise. During the transition period, there would be no additional land clearing or construction activities. Therefore, there would be no localized death or injury impact to wildlife.

Wildlife of Concern

During the 2011 greater sage-grouse listening surveys, there was no evidence of displaying greater sage-grouse, indicating no breeding habitat (i.e., leks) present within 1.6 kilometers (1 mile) of NRF (Hafla et al. 2012). No additional habitat disturbance would occur during the transition period in the areas where greater sage-grouse sign was observed during field surveys. The new facility structures would create barriers to greater sage-grouse movement and permanent loss of habitat. The new security boundary system would block greater sage-grouse movement in the area. Much of the area inside the new security boundary system would either be landscaped or unsuitable habitat for greater sage-grouse. Because alternative movement routes would be available to greater sage-grouse, impacts of habitat loss and fragmentation would be small during the New Facility Alternative transition period.

Activities in the new facility at Location 3/4 and ECF that would continue through the transition period would not disturb the areas where pygmy rabbit burrows were found. Activities in a new facility at Location 6 could disturb pygmy rabbits if any are left in the area, but rabbits would avoid human activities. The new facility structures would create barriers to pygmy rabbit movement and permanent loss of habitat. The new security boundary system and would block pygmy rabbit movement in the area. However, much of the area inside the new security boundary system would be either landscaped or unsuitable habitat for pygmy rabbits. Because alternative movement routes would be available to pygmy rabbits, impacts of habitat loss and fragmentation would be small during the New Facility Alternative transition period.

Migratory birds occasionally nest in ECF alcoves and equipment that is stored outdoors. These behaviors would continue during the transition period and birds would likely move into similar areas of a new facility. All provisions of the Migratory Bird Treaty Act and the USFWS migratory bird take permit for INL would continue to be followed during the transition period. Avoiding any injury to migratory birds or damage to active nests would continue to be a priority. Since activities during the transition period of the New Facility Alternative would not change from the baseline, there would be no impact on migratory birds.

Primary threats to bat populations (including the little brown myotis) on INL have not been established but could include loss of foraging habitat, roosting habitat, and prey base due to activities such as closure of abandoned mines (on lands surrounding INL), alteration of water resources, and pesticide use. Large-scale fires and humans entering and exploring caves have also likely affected bat species on INL. Activities during the transition period of the New Facility Alternative would not cause changes in water resources, but could increase the area of pesticide use around new facility structures. There are no caves or lava tubes around the new facility structures or in the new security boundary system area; therefore, roosting habitat would not be lost or fragmented. Bats have been observed roosting in NRF buildings that are not located near the ECF; these bats would not be impacted by the transition period of the New Facility Alternative. NRF would continue to support the INL bat monitoring program that was established to learn more about bat populations and bat ecology on INL. In addition, NRF would follow applicable conservation measures established in the bat protection plan once this plan is finalized.

Based on the number of signs of large ungulate use observed during wildlife surveys in 2011 and 2012, large ungulates (primarily pronghorn and mule deer) are transient in the undeveloped NRF area; however, no animals were sighted (Hafla et al. 2012). Large ungulates would likely avoid the new facility and ECF areas due to noise and human activity. INL big game surveys conducted from 1989 to 2011 indicate that NRF property is not within annual migration routes or preferred habitat. Therefore, the noise and human activity during the transitional period of the New Facility Alternative would have only small impacts to ungulate populations on the INL.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only examination work continues in ECF.

There would be no additional loss of vegetation due to land clearing or grading. Impacts to vegetation from storm water, noxious weeds, and non-native plants would not change from those described above for the transition period. Therefore, storm water runoff impacts of erosion and sedimentation on vegetation during the operational period of the New Facility Alternative would be small, and there would be no impact from noxious weeds or non-native plants.

There would be no additional loss of vegetation or wildlife habitat due to land clearing or grading. Impacts to wildlife (including wildlife of concern) would not change from those described for the transition period. Therefore, impacts to wildlife from habitat loss and fragmentation due to permanent structures, the new security boundary system, and avoidance due to noise during the operational period of the New Facility Alternative would be small. There would be no impact to wildlife due to localized death or injury during the operational period of the New Facility Alternative.

4.6 Air Quality

This section discusses the potential environmental impacts on air quality for the alternatives. The non-radiological and radiological aspects of air quality are discussed separately for each alternative.

4.6.1 Non-Radiological Air Emissions and Impacts

The ROI for the non-radiological air quality analysis includes public roads and receptors as defined for the INL by IDEQ (IDEQ 2011), and Federal Class I areas (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park).

The type and quantity of pollutants emitted to air from a specific source, or group of sources, is often referred to as the source term. Source terms for alternatives are generated using data from NRF facilities, project design data, and EPA approved methods. The main sources of pollutants from INL facilities that are considered in this analysis include burning fossil fuels to power boilers, emergency diesel generators (EDGs), and miscellaneous combustion sources. The estimated source terms are used in atmospheric dispersion modeling (INL 2013a, INL 2013b, INL 2013c, K-Spar Inc. 2013, and K-Spar Inc. 2016) to estimate:

- Criteria and toxic air pollutant (TAP) concentrations for ambient air (at locations of public access).
- PSD increment consumption for ambient air.
- Visibility and PSD air pollutant impacts on Federal Class I areas (near field areas are ≤ 50 kilometers (31 miles) from the source; far field areas are > 50 kilometers (31 miles) from the source).

The modeling provides an assessment of potential impacts based on estimates of emissions associated with the proposed action and emissions from INL facilities (Section 3.6.3). It is an evaluation of the pollutant concentrations at public receptor locations and Federal Class I areas in comparison to the regulatory limits or applicable standard. The analysis also provides air quality impacts to compare among alternatives.

Impacts to air quality are considered small unless a modeled pollutant concentration at a public receptor location is within 10 percent of its regulatory limit or applicable standard. Impacts are considered negligible if pollutant concentrations at a public receptor location are much less than the applicable standard.

The INL is designated as “attainment,” “better than national standards,” or “unclassifiable/attainment,” depending on the criteria pollutant being considered (40 C.F.R. § 81.313); therefore, no conformity analysis is required.

Greenhouse Gas Emissions and Climate Change

Scope 1, 2, and 3 annual greenhouse gas emissions (GHGs) are estimated for the proposed action. Scope 1 are direct emissions from production of electricity, heat, cooling, or steam; mobile combustion sources (automobiles, ships, and aircraft); fugitive emissions within an agency’s organizational boundary; and process emissions from laboratory activities. Scope 2 emissions are indirect or shared emissions associated with consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 3 emissions include all other indirect emissions not included in Scope 2 (e.g., business air/ground travel, employee commuting, contracted solid waste disposal, contracted wastewater treatment, subcontractor emissions, and transmission and distribution losses associated with purchased electricity). Scope 1, 2, and 3 emissions for the proposed action are calculated according to methods in CEQ 2012.

There is no final guidance regarding when an agency should determine the level of analysis needed for GHG emissions. The CEQ "Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts" (CEQ 2014) provides direction to federal agencies on when and how to consider the effects of GHGs and climate change. The revised draft guidance recommends use of GHG emissions as the proxy for assessing a proposed action's potential climate change impacts and provides a reference point for annual GHG emissions of 25,000 metric tons of CO_2-equivalent [MT CO_2e] below which a quantitative analysis of GHG emissions is not warranted. GHG emissions exceeding this reference point would require a more in-depth analysis and mitigation plan. The guidance states that the reference point is for purposes of disclosure and not a substitute for an agency's determination of significance under the National Environmental Policy Act (NEPA). Determination of significance should be based on both context and intensity, and the extent of the analysis should be commensurate with the quantity of projected GHG emissions. The revised guidance states that agencies should consider:

> "1) the potential effects of a proposed action on climate change as indicated by its GHG emissions; and 2) the implications of climate change for the environmental effects of a proposed action."

Effects of the Proposed Action on GHG Emissions and Climate Change

Based on projected GHG emissions it was determined that none of the alternatives would result in annual GHG emissions that would exceed the reference point of 25,000 MT CO_2e. In addition, none of the alternatives are large direct emitters of GHGs (e.g., large solid waste landfill or coal fired power plant). There are no process specific activities associated with the alternatives that generate large amounts of GHGs and primary sources are associated with general facility operations (e.g., electricity use, heating, and commuting). While there would be small increases of direct emissions (Scope 1) for the alternatives, the majority of GHGs would be indirect (Scope 2 or Scope 3). Therefore, it was determined that a quantitative analysis and mitigation plan are not warranted. A qualitative analysis of impacts from the proposed action on GHGs and climate change is provided below.

Impacts of Climate Change on the Proposed Action

Impacts of global climate change on the proposed action are expected to be the same for all alternatives. As described in Section 3.6.2.2, if global GHG emissions remain at or above current rates, impacts on global climate change would continue to occur. Impacts on the proposed action from continued climate change include threats to infrastructure and risk to worker health and safety through increased frequency and severity of extreme weather events (e.g., drought, thunderstorms, strong winds, hail, tornadoes, snow storms, dust devils, and wildfires). There is also potential for persistent drought to increase risk of power disruptions during summer months, when water shortages could lead to decreased energy production from the region's electricity facilities. Increased temperatures resulting in additional cooling demands in the summer may also impact the proposed action by contributing to power disruption or by increasing stress on cooling systems.

These potential climate change vulnerabilities can be mitigated through existing NRF safety, operations, and emergency planning processes. For example, human health and safety issues are managed through Environmental, Safety, and Health programs, and by emergency procedures for extreme weather events; wildfires are managed on a site-wide basis by the INL Fire Department and a wildfire management program which includes interagency and other cooperative support agreements to provide mutual assistance to address large wildfires; and NRF maintains a local fire protection program and emergency response program. To mitigate short-term power disruptions, an emergency power distribution system and associated procedures are in place. The adequacy of these programs and procedures in mitigating climate change vulnerabilities will continue to be evaluated through the Naval Reactors Sustainability Plan as required by DOE Order 436.1, Departmental Sustainability.

In addition, DOE Order 420.1C, Facility Safety requires NRF to conduct natural phenomena hazard assessments of facilities and to design, construct and manage facilities using a graded approach for such climate-related phenomena as: extreme winds, tornados, hurricanes, extreme floods, lightning, and extreme precipitation (i.e., snow, rain, ice, or a combination of them). Natural phenomena hazard assessments would be integrated into new facility design or the design of the overhaul which would also help to mitigate climate change vulnerabilities of the proposed action.

Based on existing NRF safety, operations, and emergency planning procedures and processes, and design requirements that mitigate climate-related phenomena, impacts of climate change on the proposed action would be small.

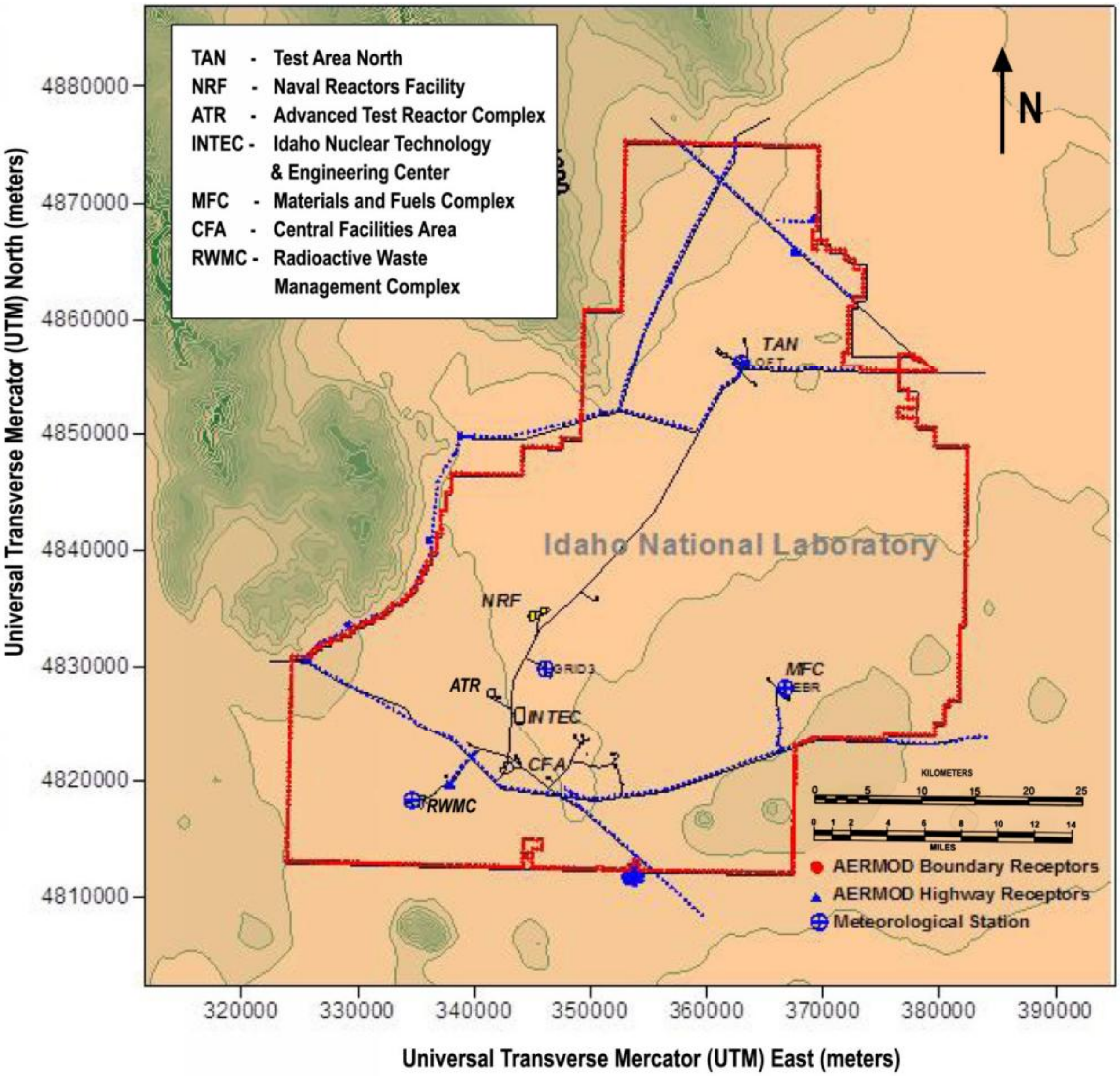
Chemical Accidents

Chemical accident scenarios are not evaluated for the proposed action. Inventories of hazardous chemicals to be used in the proposed action would not exceed the Threshold Planning Quantities as stipulated on the Extremely Hazardous Substances List provided in 40 C.F.R. § 355, Appendix A. Similarly, none of the thresholds in the List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention (40 C.F.R. § 68.130) would be exceeded for any chemicals to be used or stored at NRF. Although the total amount of sulfuric acid in lead-acid batteries at NRF may exceed the sulfuric acid Threshold Planning Quantity of 1000 pounds, the maximum quantity of sulfuric acid in any one battery is approximately 13.6 kilograms (30 pounds), and this acid is sealed within the battery casings. These are automotive-type batteries and batteries used in diesel generator starting banks. The proposed action may contain lead-acid batteries in its emergency power supply; if used, individual batteries are also anticipated to contain no more than 13.6 kilograms (30 pounds) of sulfuric acid each.

4.6.1.1 Modeling and Analyses

This section provides a brief overview of the methodology used to evaluate air quality impacts. This overview is provided upfront, with additional details in Appendix E, so that the remaining sections can focus primarily on impacts.

Atmospheric dispersion modeling for criteria and TAP concentrations at INL receptor locations is done with AERMOD, version 11103 (EPA 2004a) using 5 years of meteorological data processed through AERMET, version 06341 (EPA 2004b). See Appendix E for the AERMOD modeling methodology. The INL receptor locations (INL boundaries and public roads) were obtained from IDEQ (IDEQ 2011) and are shown in Figure 4.6-1.



Source: INL 2013a

Figure 4.6-1: INL Facilities, Meteorological Stations, and Public Receptor Locations Along Boundaries and Highways

PSD increments for Federal Class I and Class II areas have been established for specific averaging times associated with concentrations of nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM) less than or equal to 10 micrometers in diameter (PM_{10}) (Section 3.6). The INL is designated Federal Class II by PSD regulations, while Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park are designated as Federal Class I.

The degree to which the proposed action would increase PSD increment consumption depends primarily on the amount of fossil fuel burning that is needed to meet energy demands. The amount of increment consumption for the proposed action is quantitatively evaluated. PSD increment consumption is modeled for the INL and near field areas of Craters of the Moon National Monument using AERMOD as described above for criteria and toxic pollutants. CALPUFF, version 5.8, Level 070623 (Scire et al. 2000a), is used to model PSD increment consumption at far field areas of the Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park. Since part of the Craters of the Moon National Monument lies within 50 kilometers (31 miles) of the source, and part of the Craters of the Moon National Monument lies greater than 50 kilometers (31 miles) from the source, it is analyzed with both near field and far field modeling methods. Both Grand Teton National Park and Yellowstone National Park are greater than 50 kilometers (31 miles) from the source and are analyzed using methods for far field sites.

Additional air quality concerns at Federal Class I areas include visibility impairment and acid deposition (e.g., sulfur and nitrogen compounds). Initial emissions screening showed there would be no impact on visibility, deposition, or ozone formation from the project alternatives at far field Federal Class I areas (Appendix E, Section E.4).

VISCREEN is used to evaluate plume visibility for near field Federal Class I areas. Screening threshold values stipulated in FLAG 2010 are light extinction (ΔE) < 2.0 and the absolute value of color contrast ($|C|$) < 0.05. Color contrast values vary between negative and positive and depend on the scattering of blue light from particles present in the atmosphere. The addition or subtraction of blue light results in visibility impairment due to a diminished contrast between objects and the sky. ΔE is always positive and represents light extinction (absorption) caused mainly by the presence of NO_2 in the atmosphere. Changes in light extinction and contrast are estimated for the alternatives and compared to established threshold values.

4.6.1.2 Other Air Quality-Related Parameters

Ozone Formation

Ozone (O_3) is a criteria pollutant that is not emitted directly from facility sources. Instead, it forms in the atmosphere when photochemical pollutants from vehicles and industrial sources react with sunlight. These photochemical pollutants are called ozone precursors and include NO_x and volatile organic compounds (VOCs). Therefore, the regulation of O_3 is affected by control of emissions of ozone precursors.

The state of Idaho VOCs significance level is a net increase of 36 metric tons (40 U.S. short tons) per year from a new major facility or major modification as a measure of O_3 (IDAPA 58.01.01.006.106.v). VOC emissions for the proposed action are calculated using methods described in Appendix E for estimating criteria air pollutants. The bounding case for VOC emissions from new facility operations would be 0.079 metric tons (0.09 U.S short tons) per year. This would be the net increase from a new facility for both the transition period and the operational period. There would be no net increase for the Overhaul Alternative (refurbishment period or post-refurbishment operational period). These results indicate that there would be negligible ozone formation impacts from VOC emissions from the proposed action.

According to FLAG 2010, O_3 formation in most Federal Class I areas is likely limited by NO_x formation. In these areas, controlling NO_x emissions is thought to be the most effective means of limiting O_3 concentrations. Initial emissions screening (alternatives plus INL facilities) per FLAG 2010 shows no adverse impacts due to O_3 would be indicated at Grand Teton National Park, Yellowstone National Park, or Craters of the Moon National Monument far field areas (Appendix E.4.2). For near field areas of Craters of the Moon National Monument, maximum modeled NO_2 concentration using AERMOD for new facility operations plus the INL facilities (bounding case includes all operations at NRF) is 2.7×10^{-2} micrograms per cubic meter. The ratio of maximum NO_2 increment consumption to allowable PSD increment consumption is 1.1×10^{-2} (a ratio greater than 1.0 would indicate the concentration is greater than the limit). Therefore, there would be negligible ozone formation impacts from NO_x emissions from the proposed action.

Fluoride Emissions

While other INL facilities utilize processes that emit fluorides (e.g., DOE 2002c), processes associated with the proposed action do not. Therefore, an analysis of fluoride emissions is not performed.

Secondary Population Growth

Minor growth in ROI population is projected for the refurbishment and post-refurbishment periods of the Overhaul Alternative and for the construction and transition periods of the New Facility Alternative (Section 4.10). This growth would not be of a magnitude which could result in air quality impacts due to general commercial, residential, industrial, or other growth. Therefore, there would be no air quality impacts from secondary population growth from the proposed action.

4.6.1.3 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

Under the No Action Alternative, small quantities of criteria, toxic, and GHG air pollutants would continue to be generated from the burning of fuels and other activities at NRF. However, no increases in air pollutant emissions would occur. Therefore, a PSD analysis is not required. Criteria and TAP emissions generated would not change and are considered as part of the INL concentrations reported in Section 3.6 (Tables 3.6-7 through 3.6-12). GHG emissions would not change from those reported for NRF in Section 3.6 (Table 3.6-21).

There would be no non-radiological air quality impacts from the No Action Alternative.

4.6.1.4 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations.

<u>Criteria, Toxic, and PSD Air Pollutants</u>

The primary source of criteria, toxic, and PSD air pollutants during the refurbishment period would be burning fossil fuels to power boilers to heat the ECF and to test the EDGs. Refurbishment activities for the Overhaul Alternative would occur primarily within the ECF with the exception of construction of the new security boundary system. Construction of this new security boundary system would generate fugitive dust and equipment emissions. These emissions would be intermittent over a period of about 1 year and would have a negligible impact on criteria and TAP concentrations and PSD increment consumption at receptor locations.

Increased workforce traffic during the refurbishment period for the Overhaul Alternative would also generate emissions (primarily carbon monoxide (CO)). The increase in workforce traffic is estimated to be 3 percent (Section 4.2). Because the increase in workforce traffic would be small, impacts to air pollutant concentrations at receptor locations from traffic emissions would be negligible during the refurbishment period of the Overhaul Alternative.

There would be no change in unabated criteria, toxic, and PSD air pollutant emissions from boiler and EDG sources for the refurbishment period of the Overhaul Alternative from the ECF baseline established in Section 3.6 (Table 3.6-15 and Table 3.6-18) since the entire facility would continue to be heated and require emergency power. Criteria and TAP concentrations and PSD increment consumption at receptor locations would not change from those presented for the ECF in Table 3.6-16, Table 3.6-17, and Table 3.6-19, and concentrations would remain much less than the standards. Cumulative pollutant concentrations and ratios of concentrations to the standards for the refurbishment period with INL facilities are provided in Table 3.6-8, Table 3.6-9, Table 3.6-10, and Table 3.6-12. All standards would be met; there would be no impact on criteria or TAP concentrations or PSD increment consumption at receptor locations from boiler or EDG sources during the refurbishment period of the Overhaul Alternative.

Visibility at the Near Field Federal Class I Area (Craters of the Moon National Monument)

Visibility impacts at Craters of the Moon National Monument near field areas from the refurbishment period and cumulative impacts with other INL facilities are provided in Table 3.6-13. There would be no changes in ΔE and $|C|$ over the ECF baseline for the refurbishment period (Table 3.6-20). ΔE and $|C|$ are much less than established threshold values, even when modeled with INL emissions. Therefore, there would be no impact on visibility at Craters of the Moon National Monument from the refurbishment period of the Overhaul Alternative.

Greenhouse Gases

Increases in GHG emissions for the refurbishment period would be primarily from construction worker commuting (Scope 3) and an increase in purchased electricity (Scope 2). Transmission and distribution losses associated with purchased electricity would also contribute to a small increase in Scope 3 emissions. Direct emissions from boilers or EDG testing would not change from values reported in Section 3.6.3.5. There would be a small increase in direct emissions from the active sewage lagoons due to increased workforce. The total increase in annual Scope 1, 2, and 3 GHG emissions would not exceed 25,000 MT CO_2e, indicating additional analysis is not warranted. Based on these results, impacts of the refurbishment period activities on climate change would be negligible.

Post-Refurbishment Operational Period

The post-refurbishment operational period for the Overhaul Alternative addresses the 12 years after refurbishment when only operational activities would take place in the ECF.

Criteria, Toxic, and PSD Air Pollutants

The primary source of criteria, toxic, and PSD air pollutants during the post-refurbishment operational period would be burning fossil fuels to power boilers to heat the ECF and to test the EDGs.

Increased workforce traffic during the post-refurbishment operational period would also generate emissions (primarily CO). The increase in workforce traffic is estimated to be less than 1 percent (Section 4.2). Because the increase in workforce traffic would be negligible, impacts to air pollutant concentrations at receptor locations from traffic emissions would also be negligible during the post-refurbishment operational period of the Overhaul Alternative.

There would be no change in unabated criteria, toxic, and PSD air pollutant emissions from boiler and EDG sources for the post-refurbishment operational period of the Overhaul Alternative from the ECF baseline established in Section 3.6 (Table 3.6-15 and Table 3.6-18) since the entire facility would continue to be heated and require emergency power.

There would be no change to criteria or TAP concentrations or PSD increment consumption at receptor locations to those presented for the ECF in Table 3.6-16, Table 3.6-17, and Table 3.6-19, and concentrations would remain much less than the standards. Therefore, cumulative concentrations and ratios for the post-refurbishment operational period modeled with emissions from the other INL facilities would not change from those provided in Table 3.6-8, Table 3.6-9, Table 3.6-10, and Table 3.6-12. All standards would be met; there would be no impact on criteria or TAP concentrations or PSD increment consumption at receptor locations from the post-refurbishment operational period of the Overhaul Alternative.

Visibility at the Near Field Federal Class I Area (Craters of the Moon National Monument)

Visibility impacts at Craters of the Moon National Monument near field areas from the post-refurbishment operational period and cumulative impacts with other INL facilities would be the same as those provided in Table 3.6-13. There would be no changes in ΔE and |C| over the ECF baseline for the post-refurbishment operational period (Table 3.6-20). ΔE and |C| are much less than established threshold values for the post-refurbishment operational period, even when modeled with INL emissions. Therefore, there would be no impact on visibility at Craters of the Moon National Monument from the post-refurbishment operational period of the Overhaul Alternative.

Greenhouse Gases

Increases in GHG emissions for the post-refurbishment operational period would be primarily from the increase in worker commuting (Scope 3). Direct emissions from boilers or EDG testing and indirect emissions from purchased electricity would not change from values reported in Section 3.6.3.5. There would be a small increase in direct emissions from the active sewage lagoons due to increased workforce. The total increase in Scope 1, 2, and 3 GHG emissions would not exceed 25,000 MT CO_2e, indicating additional analysis is not warranted. Based on these results, impacts of the post-refurbishment operational activities on climate change would be negligible.

4.6.1.5 New Facility Alternative

Construction Period

Four modeling scenarios were established based on non-overlapping construction phases and activities (Table 4.6-1) (see Appendix E, Table E.2-10). The modeling scenarios are sequential in time (they are not alternative scenarios).

Table 4.6-1: New Facility Construction Modeling Scenarios

Modeling Scenario	Construction Phases
Scenario 1	Trenching for Utilities, Clearing/Grading, Paving Craft Parking, Roads
Scenario 2	Excavation for SFHP Building, Building & Material Delivery
Scenario 3	Batch Plant phase I, Building & Material Delivery
Scenario 4	Batch Plant phase II, Building & Material Delivery
Source: K-Spar Inc. 2016	

Air quality impacts based on modeling results are presented below for each of the construction modeling scenarios.

During construction, fugitive dust would be generated from earth moving activities, wind erosion of bare ground, and the two on-site concrete batch plants. Criteria and PSD air pollutants would be generated from on-site operation of construction vehicles and other equipment that burn fossil fuels. Criteria and PSD air pollutants would also be generated from delivery vehicles and construction workforce travel to and from the site.

Emissions for Location 3/4 and Location 6 are estimated for dispersion modeling from the construction period of the New Facility Alternative. Emissions would be similar for the two locations.

Air pollutants generated during the construction period would be in addition to those described in Section 3.6.4 for ECF. The overlap of new facility construction with ECF operations during the time periods covered by each of the construction modeling scenarios for the New Facility Alternative is accounted for in the cumulative comparisons of construction plus INL facilities to air quality standards in the tables below. The INL emissions include those from all NRF operations (including ECF).

<u>Fugitive Dust</u>

Fugitive dust emissions are estimated as PM_{10} and particulate matter less than or equal to 2.5 micrometers in diameter ($PM_{2.5}$). Best management practices (e.g., watering temporarily disturbed areas as specified by IDAPA Sections 650 and 651 of Rules for the Control of Air Pollution in Idaho) would be employed to reduce fugitive dust. As a minimum, quarterly on-site inspections of fugitive dust are performed at NRF according to permit requirements. Personnel monitoring as required by DOE Order 440.1B, or other regulatory requirements will be conducted as appropriate.

Earth-moving operations would be the main source of fugitive dust generation under Modeling Scenarios 1 and 2. Concrete batch plant operations would be the main source of fugitive dust generation under Modeling Scenarios 3 and 4. Best management practices for fugitive dust control would be utilized under Modeling Scenarios 1 and 2; however, no reduction in emissions are factored into the emission estimates. Therefore, the PM_{10} and $PM_{2.5}$ concentration estimates at receptor locations are conservative.

The batch plants would be used to mix concrete for a new facility. Conveyors, bins, dust collection systems, etc. would be part of the batch plant. The batch plants would be constructed and operated in accordance with the IDEQ General Permit to Construct for Concrete Batch Plants (IDAPA 58.01.01.200 through 228). All batch plant permit requirements would be followed. Controlled emission factors were used for various batch plant operations (e.g., silo filling and truck loading of cement) as recommended by IDEQ (see Appendix B). Impacts of fugitive dust on air quality at receptor locations are discussed below for criteria and PSD air pollutants.

Criteria, Toxic, and PSD Air Pollutants

Criteria Air Pollutants

The primary source of criteria pollutants during construction would be from on-road and off-road vehicles and from the operation of two batch plants (e.g., diesel engines to heat water in the winter and diesel generators to power the batch plants). It is likely that the batch plant operations will be electrically-powered from the NRF substation; however, three Tier 4 diesel generators and two diesel engine heaters were modeled for conservatism. Maximum ambient air pollutant concentrations at INL public receptor locations for criteria pollutants from new facility construction and new facility construction plus the INL facilities are provided in Table 4.6-2 and Table 4.6-3. Ratios of pollutant concentrations to standards are also documented in Table 4.6-2 and Table 4.6-3.

All pollutant concentrations are below their respective National Ambient Air Quality Standards (NAAQS). The 1-hour NO_2 concentration for Scenario 4 construction sources has the highest concentration-to-NAAQS standard ratio (33 percent of standard) followed by the 1-hr NO_2 concentration for Scenario 1 (28 percent of standard) (Table 4.6-2). For the construction plus INL sources, the 1-hour NO_2 concentration for Scenarios 3 and 4 (Table 4.6-3) has the highest concentration-to-NAAQS standard ratio (52 percent of the standard) followed by 24-hr PM_{10} for Scenario 2 (13 percent of the standard). Therefore, impacts on air quality due to criteria air pollutant emissions from activities during the construction period for the New Facility Alternative would be small.

Table 4.6-2: Maximum Predicted Criteria Pollutant Concentrations at INL Receptor Locations From Construction Sources for the New Facility Alternative

			Scenario 1		Scenario 2	
Pollutant[1]	Applicable Standard[2] micrograms per cubic meter	Averaging Time	Concentration micrograms per cubic meter	Ratio	Concentration micrograms per cubic meter	Ratio
CO	1.0×10^4	8-hour	6.4×10^1	6.4×10^{-3}	6.2×10^1	6.2×10^{-3}
CO	4.0×10^4	1-hour	3.7×10^2	9.3×10^{-3}	3.6×10^2	9.1×10^{-3}
NO_2	1.0×10^2	Annual	3.2×10^{-1}	3.2×10^{-3}	2.5×10^{-1}	2.5×10^{-3}
NO_2	1.9×10^2	1-hour	5.4×10^1	2.8×10^{-1}	4.2×10^1	2.2×10^{-1}
PbO	1.5×10^{-1}	Monthly[3]				
PM_{10}	1.5×10^2	24-hour	1.2×10^1	7.9×10^{-2}	2.0×10^1	1.3×10^{-1}
$PM_{2.5}$	1.2×10^1	Annual	8.9×10^{-3}	7.4×10^{-4}	7.9×10^{-3}	6.6×10^{-4}
$PM_{2.5}$	3.5×10^1	24-hour	1.0	2.9×10^{-2}	8.3×10^{-1}	2.4×10^{-2}
SO_2	7.9×10^1	Annual	2.0×10^{-3}	2.6×10^{-5}	1.8×10^{-3}	2.2×10^{-5}
SO_2	1.3×10^3	3-hour	1.7×10^{-1}	1.3×10^{-4}	1.6×10^{-1}	1.2×10^{-4}
SO_2	3.65×10^2	24-hour	3.9×10^{-2}	1.1×10^{-4}	3.4×10^{-2}	9.3×10^{-5}
SO_2	2.0×10^2	1-hour	3.8×10^{-1}	1.9×10^{-3}	3.4×10^{-1}	1.7×10^{-3}
			Scenario 3		**Scenario 4**	
CO	1.0×10^4	8-hour	6.7×10^1	6.7×10^{-3}	7.9×10^1	7.9×10^{-3}
CO	4.0×10^4	1-hour	4.0×10^2	9.9×10^{-3}	4.7×10^2	1.2×10^{-2}
NO_2	1.0×10^2	Annual	2.6×10^{-1}	2.6×10^{-3}	3.6×10^{-1}	3.6×10^{-3}
NO_2	1.9×10^2	1-hour	5.0×10^1	2.6×10^{-1}	6.2×10^1	3.3×10^{-1}
PbO	1.5×10^{-1}	Monthly[3]	4.9×10^{-6}	3.2×10^{-5}	2.4×10^{-6}	1.6×10^{-5}
PM_{10}	1.5×10^2	24-hour	2.0	1.3×10^{-2}	1.2	7.9×10^{-3}
$PM_{2.5}$	1.2×10^1	Annual	9.4×10^{-3}	7.9×10^{-4}	9.7×10^{-3}	8.1×10^{-4}
$PM_{2.5}$	3.5×10^1	24-hour	2.3×10^{-1}	6.5×10^{-3}	1.3×10^{-1}	3.8×10^{-3}
SO_2	7.9×10^1	Annual	1.8×10^{-3}	2.3×10^{-5}	2.7×10^{-3}	3.4×10^{-5}
SO_2	1.3×10^3	3-hour	1.6×10^{-1}	1.3×10^{-4}	2.2×10^{-1}	1.7×10^{-4}
SO_2	3.65×10^2	24-hour	3.2×10^{-2}	8.8×10^{-5}	5.0×10^{-2}	1.4×10^{-4}
SO_2	2.0×10^2	1-hour	3.6×10^{-1}	1.8×10^{-3}	5.1×10^{-1}	2.5×10^{-3}

Source: K-Spar Inc. 2016
[1]CO=carbon monoxide; NO_2 = nitrogen dioxide; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide.
[2]From 40 C.F.R. § 50
[3]Conservatively modeled as monthly instead of quarterly

Table 4.6-3: Maximum Predicted Criteria Pollutant Concentrations at INL Receptor Locations From Construction Sources Plus INL Baseline for the New Facility Alternative

Pollutant[1]	Applicable Standard[2] micrograms per cubic meter	Averaging Time	Scenario 1 Concentration micrograms per cubic meter	Scenario 1 Ratio	Scenario 2 Concentration micrograms per cubic meter	Scenario 2 Ratio
CO	1.0×10^4	8-hour	6.7×10^1	6.7×10^{-3}	6.5×10^1	6.5×10^{-3}
CO	4.0×10^4	1-hour	3.9×10^2	9.8×10^{-3}	3.8×10^2	9.5×10^{-3}
NO_2	1.0×10^2	Annual	8.4×10^{-1}	8.4×10^{-3}	8.4×10^{-1}	8.4×10^{-3}
NO_2	1.9×10^2	1-hour	9.5×10^1	5.0×10^{-1}	9.3×10^1	4.9×10^{-1}
PbO	1.5×10^{-1}	Monthly[3]	1.2×10^{-4}	7.7×10^{-4}	1.2×10^{-4}	7.7×10^{-4}
PM_{10}	1.5×10^2	24-hour	1.2×10^1	7.9×10^{-2}	2.0×10^1	1.3×10^{-1}
$PM_{2.5}$	1.2×10^1	Annual	4.5×10^{-2}	3.8×10^{-3}	4.5×10^{-2}	3.8×10^{-3}
$PM_{2.5}$	3.5×10^1	24-hour	1.1	3.0×10^{-2}	8.7×10^{-1}	2.5×10^{-2}
SO_2	7.9×10^1	Annual	9.7×10^{-3}	1.2×10^{-4}	9.7×10^{-3}	1.2×10^{-4}
SO_2	1.3×10^3	3-hour	4.9	3.8×10^{-3}	4.9	3.8×10^{-3}
SO_2	3.65×10^2	24-hour	6.9×10^{-1}	1.9×10^{-3}	6.8×10^{-1}	1.9×10^{-3}
SO_2	2.0×10^2	1-hour	6.4	3.2×10^{-2}	6.4	3.2×10^{-2}
			Scenario 3		**Scenario 4**	
CO	1.0×10^4	8-hour	7.0×10^1	7.0×10^{-3}	8.2×10^1	8.2×10^{-3}
CO	4.0×10^4	1-hour	4.2×10^2	1.0×10^{-2}	4.9×10^2	1.2×10^{-2}
NO_2	1.0×10^2	Annual	8.6×10^{-1}	8.6×10^{-3}	8.5×10^{-1}	8.5×10^{-3}
NO_2	1.9×10^2	1-hour	9.9×10^1	5.2×10^{-1}	9.9×10^1	5.2×10^{-1}
PbO	1.5×10^{-1}	Monthly[3]	1.2×10^{-4}	7.8×10^{-4}	1.2×10^{-4}	7.8×10^{-4}
PM_{10}	1.5×10^2	24-hour	2.1	1.4×10^{-2}	1.2	8.2×10^{-3}
$PM_{2.5}$	1.2×10^1	Annual	4.6×10^{-2}	3.8×10^{-3}	4.5×10^{-2}	3.7×10^{-3}
$PM_{2.5}$	3.5×10^1	24-hour	5.5×10^{-1}	1.6×10^{-2}	5.1×10^{-1}	1.5×10^{-2}
SO_2	7.9×10^1	Annual	9.8×10^{-3}	1.2×10^{-4}	9.7×10^{-3}	1.2×10^{-4}
SO_2	1.3×10^3	3-hour	4.9	3.8×10^{-3}	4.9	3.8×10^{-3}
SO_2	3.65×10^2	24-hour	6.8×10^{-1}	1.9×10^{-3}	6.9×10^{-1}	1.9×10^{-3}
SO_2	2.0×10^2	1-hour	6.4	3.2×10^{-2}	6.4	3.2×10^{-2}

Source: K-Spar Inc. 2016
[1]CO=carbon monoxide; NO_2 = nitrogen dioxide; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide.
[2]From 40 C.F.R. § 50
[3]Conservatively modeled as monthly instead of quarterly

TAPs

TAP emissions would be generated from operating diesel generators to power batch plant operations, diesel engines for heating batch plant materials, and from batch plant material handling. Maximum ambient TAP concentrations at INL receptor locations from new facility construction and new facility construction plus the INL facilities are provided in Table 4.6-4 and Table 4.6-5, respectively. There are no estimated TAP releases from construction sources for Scenarios 1 and 2 because TAP emissions are only estimated for fixed combustion sources. All predicted TAP concentrations are below respective TAP standards. For construction sources, arsenic has the highest concentration-to-TAP standard ratio (approximately 0.3 percent of the standard) for Scenario 3 (Table 4.6-4). For construction plus INL facilities (Table 4.6-5), arsenic also has the highest concentration-to-TAP standard ratio (approximately 13 percent of the standard) for Scenarios 3 and 4. Therefore, standards for TAPs would be met at INL public receptor locations, and impacts on air quality due to TAP emissions during the construction period of the New Facility Alternative would be negligible.

Table 4.6-4: Maximum Predicted TAP Concentrations at INL Receptor Locations From Construction Sources for the New Facility Alternative

			Scenario 3		Scenario 4	
Averaging Time	Pollutant Name	Standard[1]	Concentration	Ratio	Concentration	Ratio
		micrograms per cubic meter			micrograms per cubic meter	
	Non-Carcinogens					
24-hour	Acrolein (C_3H_4O)	1.25×10^{1}	2.4×10^{-5}	1.9×10^{-6}	1.2×10^{-5}	9.8×10^{-7}
24-hour	Ammonia (NH_3)	9.0×10^{2}	7.2×10^{-3}	8.0×10^{-6}	7.2×10^{-3}	8.0×10^{-6}
24-hour	Chromium (Cr)	2.5×10^{1}	2.0×10^{-5}	7.8×10^{-7}	7.5×10^{-6}	3.0×10^{-7}
24-hour	Copper (Cu)	5.0×10^{1}	2.5×10^{-5}	5.1×10^{-7}	1.4×10^{-5}	2.9×10^{-7}
24-hour	Ethylbenzene (C_8H_{10})	2.175×10^{4}	5.7×10^{-7}	2.6×10^{-11}	5.7×10^{-7}	2.6×10^{-11}
24-hour	Manganese (Mn)	2.5×10^{2}	1.3×10^{-4}	5.3×10^{-7}	3.2×10^{-5}	1.3×10^{-7}
24-hour	Naphthalene ($C_{10}H_8$)	2.5×10^{3}	4.1×10^{-4}	1.6×10^{-7}	2.1×10^{-4}	8.3×10^{-8}
24-hour	Phosphorus (P)	5.0	7.8×10^{-5}	1.6×10^{-5}	1.8×10^{-5}	3.6×10^{-6}
24-hour	Selenium (Se)	1.000×10^{1}	6.3×10^{-5}	6.3×10^{-6}	3.6×10^{-5}	3.6×10^{-6}
24-hour	Toluene (C_7H_8)	1.875×10^{4}	9.1×10^{-4}	4.9×10^{-8}	4.7×10^{-4}	2.5×10^{-8}
24-hour	Xylene (C_8H_{10})	2.175×10^{4}	5.9×10^{-4}	2.7×10^{-8}	3.0×10^{-4}	1.4×10^{-8}
24-hour	Zinc (ZnO)	5.0×10^{2}	2.1×10^{-5}	4.2×10^{-8}	1.2×10^{-5}	2.4×10^{-8}
	Carcinogens					
Annual	1,3 Butadiene (C_4H_6)	3.6×10^{-3}	3.6×10^{-6}	9.9×10^{-4}	8.0×10^{-7}	2.2×10^{-4}
Annual	Acetaldehyde (C_2H_4O)	4.5×10^{-1}	2.3×10^{-6}	5.1×10^{-6}	5.2×10^{-7}	1.2×10^{-6}
Annual	Arsenic (As_2O_3)	2.3×10^{-4}	7.8×10^{-7}	3.4×10^{-3}	3.2×10^{-7}	1.4×10^{-3}
Annual	Benzene (C_6H_6)	1.2×10^{-1}	7.1×10^{-5}	5.9×10^{-4}	1.6×10^{-5}	1.3×10^{-4}
Annual	Beryllium (BeO)	4.2×10^{-3}	1.1×10^{-6}	2.7×10^{-4}	5.0×10^{-7}	1.2×10^{-4}
Annual	Cadmium (CdO)	5.6×10^{-4}	4.8×10^{-7}	8.5×10^{-4}	2.1×10^{-7}	3.7×10^{-4}
Annual	Formaldehyde (HCOH)	7.7×10^{-2}	2.8×10^{-5}	3.6×10^{-4}	2.3×10^{-5}	2.9×10^{-4}
Annual	Nickel (Ni)	4.2×10^{-3}	5.0×10^{-7}	1.2×10^{-4}	1.9×10^{-7}	4.4×10^{-5}
Annual	PACS	3.0×10^{-4}	7.8×10^{-7}	2.6×10^{-3}	1.8×10^{-7}	6.0×10^{-4}

Source: K-Spar Inc. 2016
[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens)

Table 4.6-5: Maximum Predicted TAP Concentrations at INL Receptor Locations From Construction Sources Plus INL Baseline for the New Facility Alternative

			Scenario 3		Scenario 4	
Averaging Time	Pollutant Name	Standard[1]	Concentration	Ratio	Concentration	Ratio
		micrograms per cubic meter			micrograms per cubic meter	
	Non-Carcinogens					
24-hour	Acrolein (C_3H_4O)	1.25×10^{1}	2.4×10^{-4}	1.9×10^{-5}	2.3×10^{-4}	1.9×10^{-5}
24-hour	Ammonia (NH_3)	9.0×10^{2}	2.9×10^{-1}	3.2×10^{-4}	2.9×10^{-1}	3.2×10^{-4}
24-hour	Chromium (Cr)	2.5×10^{1}	1.5×10^{-4}	6.0×10^{-6}	1.5×10^{-4}	5.9×10^{-6}
24-hour	Copper (Cu)	5.0×10^{1}	3.0×10^{-4}	6.0×10^{-6}	3.0×10^{-4}	5.9×10^{-6}
24-hour	Ethylbenzene (C_8H_{10})	2.175×10^{4}	2.3×10^{-5}	1.1×10^{-9}	2.3×10^{-5}	1.1×10^{-9}
24-hour	Manganese (Mn)	2.5×10^{2}	3.1×10^{-4}	1.3×10^{-6}	3.0×10^{-4}	1.2×10^{-6}
24-hour	Naphthalene ($C_{10}H_8$)	2.5×10^{3}	7.4×10^{-4}	3.0×10^{-7}	5.9×10^{-4}	2.4×10^{-7}
24-hour	Phosphorus (P)	5.0	1.4×10^{-3}	2.8×10^{-4}	3.2×10^{-4}	6.4×10^{-5}
24-hour	Selenium (Se)	1.000×10^{1}	7.4×10^{-4}	7.4×10^{-5}	7.4×10^{-4}	7.4×10^{-5}
24-hour	Toluene (C_7H_8)	1.875×10^{4}	2.6×10^{-3}	1.4×10^{-7}	2.5×10^{-3}	1.3×10^{-7}
24-hour	Xylene (C_8H_{10})	2.175×10^{4}	1.3×10^{-3}	5.9×10^{-8}	1.1×10^{-3}	5.2×10^{-8}
24-hour	Zinc (ZnO)	5.0×10^{2}	2.5×10^{-4}	4.9×10^{-7}	2.5×10^{-4}	4.9×10^{-7}
	Carcinogens					
Annual	1,3 Butadiene (C_4H_6)	3.6×10^{-3}	8.4×10^{-6}	2.3×10^{-3}	6.0×10^{-6}	1.7×10^{-3}
Annual	Acetaldehyde (C_2H_4O)	4.5×10^{-1}	2.2×10^{-5}	5.0×10^{-5}	2.0×10^{-5}	4.5×10^{-5}
Annual	Arsenic (As_2O_3)	2.3×10^{-4}	3.0×10^{-5}	1.3×10^{-1}	3.0×10^{-5}	1.3×10^{-1}
Annual	Benzene (C_6H_6)	1.2×10^{-1}	1.7×10^{-4}	1.4×10^{-3}	1.2×10^{-4}	1.0×10^{-3}
Annual	Beryllium (BeO)	4.2×10^{-3}	4.8×10^{-5}	1.2×10^{-2}	4.8×10^{-5}	1.2×10^{-2}
Annual	Cadmium (CdO)	5.6×10^{-4}	2.0×10^{-5}	3.6×10^{-2}	2.0×10^{-5}	3.5×10^{-2}
Annual	Formaldehyde (HCOH)	7.7×10^{-2}	2.6×10^{-3}	3.4×10^{-2}	2.6×10^{-3}	3.4×10^{-2}
Annual	Nickel (Ni)	4.2×10^{-3}	1.8×10^{-5}	4.2×10^{-3}	1.7×10^{-5}	4.1×10^{-3}
Annual	PACS	3.0×10^{-4}	1.9×10^{-6}	6.3×10^{-3}	1.4×10^{-6}	4.5×10^{-3}

Source: K-Spar Inc. 2016
[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens)

PSD Air Pollutants

Maximum projected PSD increment consumption and ratios to standards at Federal Class I and Class II areas from new facility construction and new facility construction plus INL facilities are provided in Table 4.6-6 and Table 4.6-7, respectively.

Ratios of the increment consumption to the allowable PSD increment at INL public receptors and near field areas of Craters of the Moon National Monument are less than 1.0 for all modeling scenarios, indicating standards would be met, even when construction sources are modeled cumulatively with the emissions from the other INL facilities (including the rest of NRF). For construction sources (Table 4.6-6), the two pollutants that are closest to their respective limits are 24-hr PM_{10} for Scenario 2 (67 percent of the limit), followed by 24-hr $PM_{2.5}$ for Scenario 1 (11 percent of the limit). For construction plus INL facilities (Table 4.6-7), the two pollutants that are closest to their respective limits are 24-hr PM_{10} for Scenario 2 (67 percent of the limit), followed by 24-hr $PM_{2.5}$ for Scenario 1 (12 percent of the limit). Scenarios 1 and 2 represent the construction phases that are dominated by dust generating activities such as clearing, grading, and excavation (see Table 4.6-1). Dust control measures such as watering bare ground or other controls are not considered in the analysis. Dust control measures would be used during the construction phases included in Scenarios 1 and 2 and would significantly lower PM_{10} emissions. Reasonable fugitive dust controls would be performed during construction according to permit rules and IDAPA Sections 650 and 651 of the Rules for the Control of Air Pollution in Idaho. In addition, best management practices would be used to minimize the production of nitrates and sulfates. These practices include use of ultra-low sulfur diesel fuel, limiting engine idling, and using electrical power (as opposed to diesel generators) for temporary heat and lighting the facility during construction. Therefore, impacts to air quality at the INL receptors (Class II) would be small.

Table 4.6-6: PSD Increment Consumption at Federal Class II Areas for Construction Sources for the New Facility Alternative

Pollutant	Averaging Time	Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads	Ratio of Maximum Increment Consumed to Allowable PSD Increment
		micrograms per cubic meter			micrograms per cubic meter	
			Scenario 1		**Scenario 2**	
NO_2	Annual	2.5×10^{1}	3.2×10^{-1}	1.3×10^{-2}	2.5×10^{-1}	9.8×10^{-3}
PM_{10}	24-hour	3.0×10^{1}	1.2×10^{1}	4.0×10^{-1}	2.0×10^{1}	6.7×10^{-1}
	Annual	1.7×10^{1}	2.1×10^{-2}	1.2×10^{-3}	2.0×10^{-2}	1.2×10^{-3}
$PM_{2.5}$	24-hour	9.0	1.0	1.1×10^{-1}	8.3×10^{-1}	9.3×10^{-2}
	Annual	4.0	8.9×10^{-3}	2.2×10^{-3}	7.9×10^{-3}	2.0×10^{-3}
SO_2	3-hour	5.12×10^{2}	1.7×10^{-1}	3.3×10^{-4}	1.6×10^{-1}	3.1×10^{-4}
	24-hour	9.1×10^{1}	3.9×10^{-2}	4.3×10^{-4}	3.4×10^{-2}	3.8×10^{-4}
	Annual	2.0×10^{1}	2.0×10^{-3}	1.0×10^{-4}	1.8×10^{-3}	8.8×10^{-5}
			Scenario 3		**Scenario 4**	
NO_2	Annual	2.5×10^{1}	2.6×10^{-1}	1.1×10^{-2}	3.6×10^{-1}	1.4×10^{-2}
PM_{10}	24-hour	3.0×10^{1}	2.0	6.7×10^{-2}	1.2	3.9×10^{-2}
	Annual	1.7×10^{1}	1.7×10^{-2}	1.0×10^{-3}	1.7×10^{-2}	9.8×10^{-4}
$PM_{2.5}$	24-hour	9.0	2.3×10^{-1}	2.5×10^{-2}	1.3×10^{-1}	1.5×10^{-2}
	Annual	4.0	9.4×10^{-3}	2.4×10^{-3}	9.7×10^{-3}	2.4×10^{-3}
SO_2	3-hour	5.12×10^{2}	1.6×10^{-1}	3.2×10^{-4}	2.2×10^{-1}	4.4×10^{-4}
	24-hour	9.1×10^{1}	3.2×10^{-2}	3.5×10^{-4}	5.0×10^{-2}	5.5×10^{-4}
	Annual	2.0×10^{1}	1.8×10^{-3}	9.2×10^{-5}	2.7×10^{-3}	1.3×10^{-4}
Source: K-Spar Inc. 2016						

Table 4.6-7: PSD Increment Consumption at Federal Class II Areas From Construction Sources Plus INL Baseline for the New Facility Alternative

Pollutant	Averaging Time	Allowable PSD Increment (micrograms per cubic meter)	Maximum Predicted Increment Consumed for INL Boundary and Public Roads (micrograms per cubic meter)	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads (micrograms per cubic meter)	Ratio of Maximum Increment Consumed to Allowable PSD Increment
			Scenario 1		**Scenario 2**	
NO_2	Annual	2.5×10^{1}	8.4×10^{-1}	3.4×10^{-2}	8.4×10^{-1}	3.4×10^{-2}
PM_{10}	24-hour	3.0×10^{1}	1.2×10^{1}	4.0×10^{-1}	2.0×10^{1}	6.7×10^{-1}
	Annual	1.7×10^{1}	4.8×10^{-2}	2.8×10^{-3}	5.1×10^{-2}	3.0×10^{-3}
$PM_{2.5}$	24-hour	9.0	1.1	1.2×10^{-1}	8.7×10^{-1}	9.6×10^{-2}
	Annual	4.0	4.5×10^{-2}	1.1×10^{-2}	4.5×10^{-2}	1.1×10^{-2}
SO_2	3-hour	5.12×10^{2}	4.9	9.5×10^{-3}	4.9	9.5×10^{-3}
	24-hour	9.1×10^{1}	6.9×10^{-1}	7.5×10^{-3}	6.8×10^{-1}	7.5×10^{-3}
	Annual	2.0×10^{1}	9.7×10^{-3}	4.8×10^{-4}	9.7×10^{-3}	4.8×10^{-4}
			Scenario 3		**Scenario 4**	
NO_2	Annual	2.5×10^{1}	8.6×10^{-1}	3.4×10^{-2}	8.5×10^{-1}	3.4×10^{-2}
PM_{10}	24-hour	3.0×10^{1}	2.1	6.8×10^{-2}	1.2	4.1×10^{-2}
	Annual	1.7×10^{1}	4.8×10^{-2}	2.9×10^{-3}	4.5×10^{-2}	2.7×10^{-3}
$PM_{2.5}$	24-hour	9.0	5.5×10^{-1}	6.1×10^{-2}	5.1×10^{-1}	5.7×10^{-2}
	Annual	4.0	4.6×10^{-2}	1.1×10^{-2}	4.5×10^{-2}	1.1×10^{-2}
SO_2	3-hour	5.12×10^{2}	4.9	9.5×10^{-3}	4.9	9.5×10^{-3}
	24-hour	9.1×10^{1}	6.8×10^{-1}	7.5×10^{-3}	6.9×10^{-1}	7.5×10^{-3}
	Annual	2.0×10^{1}	9.8×10^{-3}	4.9×10^{-4}	9.7×10^{-3}	4.9×10^{-4}

Source: K-Spar Inc. 2016

Predicted concentrations of PSD pollutants at the Class I receptors located less than 50-km from the source at Craters of the Moon National Monument are presented in Table 4.6-8 for construction sources and Table 4.6-9 for construction plus INL facilities. Comparison to PSD Class I increment limits are included these tables. The ratios of pollutant concentrations to the PSD Class I increment limits are much less than 1.0, indicating standards would be met, even when the construction period is modeled cumulatively with the emissions from the other INL facilities (including the rest of NRF). The two pollutants that are closest to their respective limits for construction sources (Table 4.6-8) are 24-hr PM_{10} (3.7 percent of the limit for Scenario 2), followed by 24-hr $PM_{2.5}$ (1.3 percent of the limit for Scenario 1). For construction plus INL facilities (Table 4.6-9), the two pollutants that are closest to their respective limits are 24-hr PM_{10} (3.8 percent of the limit for Scenario 2), followed by 24-hr $PM_{2.5}$ (2.0 percent of the limit for Scenario 1). Therefore, impacts to air quality at the near field Class I receptors would be small.

Table 4.6-8: PSD Increment Consumption at Near Field Craters of the Moon National Monument From Construction Sources for the New Facility Alternative

Pollutant	Averaging Time	Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads	Ratio of Maximum Increment Consumed to Allowable PSD Increment
		micrograms per cubic meter			micrograms per cubic meter	
			Scenario 1		Scenario 2	
NO_2	Annual	2.5	8.5×10^{-4}	3.4×10^{-4}	8.6×10^{-4}	3.4×10^{-4}
PM_{10}	24-hour	8.0	1.8×10^{-1}	2.2×10^{-2}	3.0×10^{-1}	3.7×10^{-2}
	Annual	4.0	1.0×10^{-3}	2.5×10^{-4}	1.7×10^{-3}	4.2×10^{-4}
$PM_{2.5}$	24-hour	2.0	2.7×10^{-2}	1.3×10^{-2}	2.2×10^{-2}	1.1×10^{-2}
	Annual	1.0	3.7×10^{-4}	3.7×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
SO_2	3-hour	2.5×10^1	4.5×10^{-3}	1.8×10^{-4}	4.1×10^{-3}	1.6×10^{-4}
	24-hour	5.0	5.8×10^{-4}	1.2×10^{-4}	5.3×10^{-4}	1.1×10^{-4}
	Annual	2.0	4.3×10^{-6}	2.2×10^{-6}	4.2×10^{-6}	2.1×10^{-6}
			Scenario 3		Scenario 4	
NO_2	Annual	2.5	2.4×10^{-3}	9.6×10^{-4}	2.1×10^{-3}	8.6×10^{-4}
PM_{10}	24-hour	8.0	2.8×10^{-2}	3.5×10^{-3}	2.2×10^{-2}	2.8×10^{-3}
	Annual	4.0	3.2×10^{-4}	7.9×10^{-5}	1.9×10^{-4}	4.9×10^{-5}
$PM_{2.5}$	24-hour	2.0	4.9×10^{-3}	2.5×10^{-3}	5.4×10^{-3}	2.7×10^{-3}
	Annual	1.0	1.6×10^{-4}	1.6×10^{-4}	1.2×10^{-4}	1.2×10^{-4}
SO_2	3-hour	2.5×10^1	4.4×10^{-3}	1.8×10^{-4}	6.5×10^{-3}	2.6×10^{-4}
	24-hour	5.0	6.5×10^{-4}	1.3×10^{-4}	8.8×10^{-4}	1.8×10^{-4}
	Annual	2.0	1.1×10^{-5}	5.4×10^{-6}	1.1×10^{-5}	5.4×10^{-6}

Source: K-Spar Inc. 2016

Table 4.6-9: PSD Increment Consumption at Near Field Craters of the Moon National Monument From Construction Sources Plus INL Baseline for the New Facility Alternative

Pollutant	Averaging Time	Allowable PSD Increment (micrograms per cubic meter)	Maximum Predicted Increment Consumed for INL Boundary and Public Roads (micrograms per cubic meter)	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed for INL Boundary and Public Roads (micrograms per cubic meter)	Ratio of Maximum Increment Consumed to Allowable PSD Increment
			Scenario 1		Scenario 2	
NO_2	Annual	2.5	1.9×10^{-2}	7.7×10^{-3}	1.9×10^{-2}	7.7×10^{-3}
PM_{10}	24-hour	8.0	1.9×10^{-1}	2.4×10^{-2}	3.1×10^{-1}	3.8×10^{-2}
	Annual	4.0	1.6×10^{-3}	3.9×10^{-4}	2.2×10^{-3}	5.6×10^{-4}
$PM_{2.5}$	24-hour	2.0	4.0×10^{-2}	2.0×10^{-2}	3.5×10^{-2}	1.8×10^{-2}
	Annual	1.0	9.3×10^{-4}	9.3×10^{-4}	8.6×10^{-4}	8.6×10^{-4}
SO_2	3-hour	2.5×10^1	7.9×10^{-2}	3.1×10^{-3}	7.8×10^{-2}	3.1×10^{-3}
	24-hour	5.0	1.1×10^{-2}	2.2×10^{-3}	1.1×10^{-2}	2.2×10^{-3}
	Annual	2.0	2.0×10^{-4}	9.8×10^{-5}	2.0×10^{-4}	9.8×10^{-5}
			Scenario 3		Scenario 4	
NO_2	Annual	2.5	2.1×10^{-2}	8.4×10^{-3}	2.1×10^{-2}	8.3×10^{-3}
PM_{10}	24-hour	8.0	4.8×10^{-2}	6.0×10^{-3}	4.3×10^{-2}	5.4×10^{-3}
	Annual	4.0	9.2×10^{-4}	2.3×10^{-4}	8.0×10^{-4}	2.0×10^{-4}
$PM_{2.5}$	24-hour	2.0	1.9×10^{-2}	9.6×10^{-3}	2.0×10^{-2}	9.8×10^{-3}
	Annual	1.0	7.4×10^{-4}	7.4×10^{-4}	7.0×10^{-4}	7.0×10^{-4}
SO_2	3-hour	2.5×10^1	7.9×10^{-2}	3.1×10^{-3}	8.0×10^{-2}	3.2×10^{-3}
	24-hour	5.0	1.1×10^{-2}	2.2×10^{-3}	1.1×10^{-2}	2.2×10^{-3}
	Annual	2.0	2.0×10^{-4}	1.0×10^{-4}	2.0×10^{-4}	1.0×10^{-4}

Source: K-Spar Inc. 2016

The CALPUFF simulation for Class I receptors located greater than 50-km from the source was performed for Scenario 4 with and without INL facilities included. All predicted concentrations are less than the PSD Class I increment limits (Table 4.6-10). For construction sources, the pollutant concentration that is closest to the limit is the 24-hr $PM_{2.5}$ concentration (0.4 percent of the limit) at Craters of the Moon National Monument. The pollutant concentration that is closest to the limit for construction plus INL facilities is the 24-hr $PM_{2.5}$ concentration (1.2 percent of the limit) at Craters of the Moon National Monument. The ratios of maximum predicted increment consumed to the allowable PSD increment for far field Craters of the Moon National Monument, Yellowstone National Park, and Grand Teton National Park, are much less than 1.0 for the construction period when modeled cumulatively with emissions from the other INL facilities (including the rest of NRF). This indicates that PSD standards would be met at far field Federal Class I areas. Therefore, impacts to air quality at far field Federal Class I areas would be negligible during the construction period of the New Facility Alternative.

Table 4.6-10: PSD Increment Consumption at Far Field Class I Areas From Construction Scenario 4 and From Construction Scenario 4 Plus INL Baseline for the New Facility Alternative

Pollutant	Averaging Time	Scenario	Allowable PSD Increment	Craters of the Moon National Monument		Grand Teton National Park		Yellowstone National Park	
				Maximum Predicted Increment Consumed	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed	Ratio of Maximum Increment Consumed to Allowable PSD Increment	Maximum Predicted Increment Consumed	Ratio of Maximum Increment Consumed to Allowable PSD Increment
			micrograms per cubic meter			micrograms per cubic meter		micrograms per cubic meter	
Construction Sources									
NO_2	Annual	4	2.5	1.0×10^{-3}	4.0×10^{-4}	2.6×10^{-5}	1.1×10^{-5}	5.4×10^{-5}	2.2×10^{-5}
SO_2	3-hour	4	25.0	2.3×10^{-3}	9.3×10^{-5}	8.2×10^{-5}	3.3×10^{-6}	2.0×10^{-4}	8.1×10^{-6}
	24-hour	4	5.0	3.2×10^{-4}	6.4×10^{-5}	1.3×10^{-5}	2.6×10^{-6}	2.8×10^{-5}	5.6×10^{-6}
	Annual	4	2.0	9.7×10^{-6}	4.8×10^{-6}	4.8×10^{-7}	2.4×10^{-7}	7.9×10^{-7}	3.9×10^{-7}
$PM_{2.5}$	24-hour	4	2.0	8.0×10^{-3}	4.0×10^{-3}	3.6×10^{-4}	1.8×10^{-4}	6.7×10^{-4}	3.4×10^{-4}
	Annual	4	1.0	4.9×10^{-4}	4.9×10^{-4}	2.6×10^{-5}	2.6×10^{-5}	4.1×10^{-5}	4.1×10^{-5}
PM_{10}	24-hour	4	8.0	8.9×10^{-3}	1.1×10^{-3}	2.2×10^{-4}	2.8×10^{-5}	6.4×10^{-4}	8.0×10^{-5}
	Annual	4	4.0	4.8×10^{-4}	1.2×10^{-4}	1.9×10^{-5}	4.6×10^{-6}	3.0×10^{-5}	7.4×10^{-6}
Construction Sources Plus INL Baseline Sources									
NO_2	Annual	4	2.5	1.5×10^{-2}	5.8×10^{-3}	2.3×10^{-4}	9.2×10^{-5}	4.4×10^{-4}	1.8×10^{-4}
SO_2	3-hour	4	25.0	8.7×10^{-3}	3.5×10^{-4}	5.8×10^{-4}	2.3×10^{-5}	9.0×10^{-4}	3.6×10^{-5}
	24-hour	4	5.0	2.3×10^{-3}	4.6×10^{-4}	1.7×10^{-4}	3.4×10^{-5}	2.7×10^{-4}	5.4×10^{-5}
	Annual	4	2.0	2.2×10^{-4}	1.1×10^{-4}	1.2×10^{-5}	5.9×10^{-6}	1.9×10^{-5}	9.3×10^{-6}
$PM_{2.5}$	24-hour	4	2.0	2.3×10^{-2}	1.2×10^{-2}	1.9×10^{-3}	9.5×10^{-4}	2.3×10^{-3}	1.2×10^{-3}
	Annual	4	1.0	3.5×10^{-3}	3.5×10^{-3}	1.7×10^{-4}	1.7×10^{-4}	2.8×10^{-4}	2.8×10^{-4}
PM_{10}	24-hour	4	8.0	2.1×10^{-2}	2.7×10^{-3}	1.1×10^{-3}	1.4×10^{-4}	1.4×10^{-3}	1.8×10^{-4}
	Annual	4	4.0	3.0×10^{-3}	7.6×10^{-4}	1.1×10^{-4}	2.7×10^{-5}	1.8×10^{-4}	4.4×10^{-5}

Source: K-Spar Inc. 2016

Visibility at the Near Field Federal Class I Area (Craters of the Moon National Monument)

Visibility impacts from the construction period at near field areas of the Craters of the Moon National Monument are provided in Table 4.6-11. Increases in ΔE and |C| are less than established threshold values even when modeled with emissions from the other INL facilities (including the rest of NRF).

Scenarios 1 and 2 for construction only and construction plus INL baseline sources required Level II screening to achieve ΔE and |C| values less than 2.0 and 0.05, respectively. Estimates of ΔE and |C| for Scenarios 1 and 2 are based on Stability Class E and 2 meters per second wind speed (See Appendix E). Scenarios 3 and 4 for construction only and construction plus INL sources have acceptable ΔE and |C| values using Level I meteorology (Stability Class F and 1 meter per second wind speed). Therefore, impacts on visibility at Craters of the Moon National Monument from the construction period of the New Facility Alternative would be small.

Table 4.6-11: Visibility Impacts at Craters of the Moon National Monument Near Field Areas From Construction Sources and Construction Sources Plus INL Baseline for the New Facility Alternative

Scenario	Background	Theta	Azimuth	Distance		Alpha	ΔE[1] (Threshold Value = 2)	|C|[2] (Threshold Value = 0.05)
				kilometers	miles			
INL Baseline	Sky	10	145	45.6	28.3	24	0.736	-0.006
	Sky	140	145	45.6	28.3	24	0.636	-0.01
	Terrain	10	84	32	19.9	84	0.341	0.002
	Terrain	140	84	32	19.9	84	0.133	0.001
Scenario 1 + INL Baseline	Sky	10	94	50	31.1	75	0.207	0.004
	Sky	140	94	50	31.1	75	0.124	-0.003
	Terrain	10	84	48.4	30.1	84	0.721	0.005
	Terrain	140	84	48.4	30.1	84	0.045	0.001
Scenario 1	Sky	10	94	50	31.1	75	0.223	0.005
	Sky	140	94	50	31.1	75	0.045	-0.001
	Terrain	10	84	48.4	30.1	84	0.675	0.005
	Terrain	140	84	48.4	30.1	84	0.027	0
Scenario 2 + INL Baseline	Sky	10	94	50	31.1	75	0.35	0.008
	Sky	140	94	50	31.1	75	0.142	-0.003
	Terrain	10	84	48.4	30.1	84	1.166	0.009
	Terrain	140	84	48.4	30.1	84	0.059	0.001
Scenario 2	Sky	10	94	50	31.1	75	0.379	0.008
	Sky	140	94	50	31.1	75	0.069	-0.002
	Terrain	10	84	48.4	30.1	84	1.122	0.008
	Terrain	140	84	48.4	30.1	84	0.045	0.001
Scenario 3 + INL Baseline	Sky	10	145	45.6	28.3	24	1.063	-0.004
	Sky	140	145	45.6	28.3	24	1.012	-0.018
	Terrain	10	84	32	19.9	84	1.066	0.007
	Terrain	140	84	32	19.9	84	0.215	0.001

Table 4.6-11: Visibility Impacts at Craters of the Moon National Monument Near Field Areas From Construction Sources and Construction Sources Plus INL Baseline for the New Facility Alternative (cont.)

Scenario	Background	Theta	Azimuth	Distance		Alpha	ΔE[1] (Threshold Value = 2)	|C|[2] (Threshold Value = 0.05)
				kilometers	miles			
Scenario 3	Sky	10	150	49.8	30.9	19	0.395	0.002
	Sky	140	150	49.8	30.9	19	0.378	-0.008
	Terrain	10	84	32	19.9	84	0.76	0.005
	Terrain	140	84	32	19.9	84	0.083	0.001
Scenario 4 + INL baseline	Sky	10	145	45.6	28.3	24	1.144	-0.006
	Sky	140	145	45.6	28.3	24	1.065	-0.018
	Terrain	10	84	32	19.9	84	0.959	0.007
	Terrain	140	84	32	19.9	84	0.226	0.001
Scenario 4	Sky	10	145	45.6	28.3	24	0.444	0
	Sky	140	145	45.6	28.3	24	0.442	-0.008
	Terrain	10	84	32	19.9	84	0.645	0.004
	Terrain	140	84	32	19.9	84	0.093	0.001

[1]Change in light extinction (i.e., absorption) caused mainly by the presence of NO_2 in the atmosphere when viewed against different backgrounds (e.g., sky and terrain). Screening values < 2 indicate light extinction would not be impacted.
[2] Absolute value of color contrast which represents impacts on blue light due to scattering from particulates in the atmosphere when viewed against different backgrounds. Screening values < 0.05 indicate color contrast would not be impacted.

Greenhouse Gases

Increases in GHG emissions for the construction period would be primarily from diesel generators and engines to power the batch plants, construction worker commuting and material deliveries, and on-site operation of construction equipment. Use of diesel generators and engines for batch plant operations under Scenarios 3 and 4 would contribute to direct emissions (Scope 1). An increase in purchased electricity (Scope 2) and associated increase in transmission and distribution losses (Scope 3) would contribute to indirect emissions under Scenarios 3 and 4. In addition, construction worker commuting (all modeling scenarios), material deliveries (Modeling Scenarios 2, 3, and 4) and on-site operation of construction equipment (primarily Modeling Scenarios 1 and 2) would contribute to Scope 3 emissions. The total increase in annual Scope 1, 2, and 3 GHG emissions would be less than 25,000 MT CO_2e for each of the modeling scenarios, indicating additional analysis is not warranted. Based on these results, impacts from construction period activities on climate change would be negligible.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. For the New Facility Alternative, electric boilers may be used in place of fuel oil-fired boilers to reduce emissions. However, emissions from fuel oil-fired boilers are evaluated for conservatism. Fuel oil-fired boilers and EDG testing would be the primary sources of criteria, PSD, and TAPs during the transition period for the New Facility Alternative.

Increased workforce traffic from commuting during the transition period would also generate emissions (primarily CO). The increase in workforce traffic is estimated to be less than 1 percent (Section 4.2). Because the increase in workforce traffic would be negligible, impacts to air pollutant concentrations at receptor locations from traffic emissions would be negligible during the transition period of the New Facility Alternative.

Air pollutants generated by the New Facility Alternative during the transition period would be in addition to those described in Section 3.6. The INL baseline emissions include those NRF operations (including ECF). Therefore, the transition period is accounted for in the cumulative (new facility operations modeled with other INL facilities) concentration comparisons to air quality standards in the tables below. This approach provides a realistic estimate of the pollutant concentrations at receptor locations from all INL activities.

Emissions due to operations are based on a notional facility to bound emissions at Location 3/4 and Location 6. Therefore, operations emissions considered for atmospheric dispersion modeling apply to either location.

<u>Criteria, Toxic, and PSD Air Pollutants</u>

Criteria Air Pollutants

Maximum ambient criteria air pollutant concentrations at INL receptor locations from new facility operations are provided in Table 4.6-12. Increases in pollutant concentrations from new facility operations would be negligible. With one exception, the ratios of pollutant concentrations to standards are much less than 1.0, indicating the standards would be met even when modeled with emissions from other INL facilities (including the rest of NRF). While the 1-hour averaging time for NO_2 is about 50 percent of the standard for INL cumulative impacts, the projected increase in NO_2 concentration due to new facility operations is small (about 6 percent of the standard) and not the main source for this pollutant. Therefore, impacts on air quality due to criteria air pollutant emissions during the transition period of the New Facility Alternative would be negligible.

TAPs

Maximum ambient TAP concentrations at INL receptor locations from new facility operations are provided in Table 4.6-13. Increases in pollutant concentrations during new facility operations would be negligible at public receptor locations for all TAPs and averaging times. When modeled with emissions from other INL facilities (including the rest of NRF), the ratios of TAP concentrations to the standards are much less than 1.0. Therefore, standards for TAPs would be met at INL public receptor locations; and impacts on air quality due to TAP emissions during the transition period of the New Facility Alternative would be negligible.

PSD Air Pollutants

Maximum projected PSD increment consumption at Federal Class I and Class II areas for new facility operations are provided in Table 4.6-14. Increment consumption from new facility operations would be negligible for all PSD pollutants and averaging times. Pollutant standards would be met as indicated by the ratio of increment consumption to the allowable PSD increments that are much less than 1.0. This is also the case when new facility operations are modeled with emissions from other INL facilities (including the rest of NRF). Therefore, PSD air pollutant standards would be met; and impacts on air quality at Federal Class I and Class II areas due to PSD air pollutant emissions during the transition period of the New Facility Alternative would be negligible.

Table 4.6-12: Maximum Predicted Criteria Pollutant Concentrations at INL Receptor Locations During the Transition Period of the New Facility Alternative

Pollutant[1]	Applicable Standard[2] micrograms per cubic meter	Averaging Time	New Facility Increase micrograms per cubic meter	Ratio of Pollutant Concentration to Standards[3]	New Facility Increase Plus INL Baseline micrograms per cubic meter	Ratio of Pollutant Concentration to Standards[4]
CO	4.0×10^{4}	1-hour	1.2×10^{1}	3.0×10^{-4}	8.9×10^{1}	2.2×10^{-3}
	1.0×10^{4}	8-hour	1.6	1.6×10^{-4}	1.4×10^{1}	1.4×10^{-3}
NO_2	1.9×10^{2}	1-hour	1.1×10^{1}	5.7×10^{-2}	9.8×10^{1}	5.1×10^{-1}
	1.0×10^{2}	Annual	6.0×10^{-2}	6.0×10^{-4}	7.0×10^{-1}	7.0×10^{-3}
Pb	1.5×10^{-1}	Quarterly[5]	2.1×10^{-6}	1.4×10^{-5}	9.9×10^{-5}	6.6×10^{-4}
PM_{10}	1.5×10^{2}	24-hour	7.2×10^{-2}	4.8×10^{-4}	2.0	1.3×10^{-2}
$PM_{2.5}$	3.5×10^{1}	24-hour	2.9×10^{-2}	8.3×10^{-4}	6.8×10^{-1}	1.9×10^{-2}
	1.2×10^{1}	Annual	1.4×10^{-3}	1.1×10^{-4}	3.6×10^{-2}	3.0×10^{-3}
SO_2	2.0×10^{2}	1-hour	3.6×10^{-2}	1.8×10^{-4}	6.5	3.2×10^{-2}
	1.3×10^{3}	3-hour	2.5×10^{-2}	1.9×10^{-5}	1.4×10^{1}	1.1×10^{-2}

Source: INL 2013a

[1] CO=carbon monoxide; NO_2 = nitrogen dioxide; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide.

[2] From 40 C.F.R. § 50.

[3] New facility operations.

[4] New facility operations plus the INL baseline.

[5] Rolling 3-month average.

Table 4.6-13: Maximum Predicted Toxic Pollutant Concentrations at INL Receptor Locations During the Transition Period of the New Facility Alternative

Pollutant	Applicable Standard[1] micrograms per cubic meter	Averaging Time	New Facility Increase micrograms per cubic meter	Ratio of Pollutant Concentration to Standards[2]	New Facility Increase Plus INL Baseline micrograms per cubic meter	Ratio of Pollutant Concentration to Standards[3]
Non-Carcinogens						
Acrolein (C_3H_4O)	1.25×10^{1}	24-hour	7.4×10^{-6}	5.9×10^{-7}	7.0×10^{-4}	5.6×10^{-5}
Ammonia (NH_3)	9.0×10^{2}	24-hour	1.1×10^{-2}	1.3×10^{-5}	2.5×10^{-1}	2.8×10^{-4}
Chromium (Cr)	2.5×10^{1}	24-hour	8.0×10^{-6}	3.2×10^{-7}	1.3×10^{-4}	5.2×10^{-6}
Copper (Cu)	5.0×10^{1}	24-hour	1.6×10^{-5}	3.2×10^{-7}	2.6×10^{-4}	5.2×10^{-6}
Ethylbenzene (C_8H_{10})	2.175×10^{4}	24-hour	9.0×10^{-7}	4.2×10^{-11}	2.0×10^{-5}	9.2×10^{-10}
Manganese (Mn)	2.5×10^{2}	24-hour	1.6×10^{-5}	6.4×10^{-8}	2.6×10^{-4}	1.0×10^{-6}
Naphthalene ($C_{10}H_8$)	2.5×10^{3}	24-hour	1.3×10^{-4}	5.1×10^{-8}	1.1×10^{-3}	4.5×10^{-7}
Selenium (Se)	1.000×10^{1}	24-hour	4.0×10^{-5}	4.0×10^{-6}	6.5×10^{-4}	6.5×10^{-5}
Toluene (C_7H_8)	1.875×10^{4}	24-hour	3.0×10^{-4}	1.6×10^{-8}	4.2×10^{-3}	2.2×10^{-7}
Xylene (C_8H_{10})	2.175×10^{4}	24-hour	1.8×10^{-4}	8.4×10^{-9}	2.8×10^{-3}	1.3×10^{-7}
Zn as zinc oxide (ZnO)	5.0×10^{2}	24-hour	1.3×10^{-5}	2.7×10^{-8}	2.2×10^{-4}	4.3×10^{-7}
Carcinogens						
1,3-Butadiene (C_4H_6)	3.6×10^{-3}	Annual	6.2×10^{-7}	1.7×10^{-4}	5.9×10^{-6}	1.7×10^{-3}
Acetaldehyde (C_2H_4O)	4.5×10^{-1}	Annual	4.0×10^{-7}	8.9×10^{-7}	2.4×10^{-5}	5.4×10^{-5}
As as arsenic trioxide (As_2O_3)	2.3×10^{-4}	Annual	4.0×10^{-7}	1.7×10^{-3}	2.5×10^{-5}	1.1×10^{-1}

Source: INL 2013a
[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens).
[2] New facility operational increase.
[3] New facility operational increase plus the INL baseline.
[4] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, ibenzo(a,h)anthracene, chrysene.

Table 4.6-13: Maximum Predicted Toxic Pollutant Concentrations at INL Receptor Locations During the Transition Period of the New Facility Alternative (cont.)

Pollutant	Applicable Standard[1]	Averaging Time	New Facility Increase	Ratio of Pollutant Concentration to Standards[2]	New Facility Increase Plus INL Baseline	Ratio of Pollutant Concentration to Standards[3]
	micrograms per cubic meter		micrograms per cubic meter		micrograms per cubic meter	
Benzene (C_6H_6)	1.2×10^{-1}	Annual	1.3×10^{-5}	1.0×10^{-4}	1.2×10^{-4}	9.9×10^{-4}
Be as beryllium oxide (BeO)	4.2×10^{-3}	Annual	6.3×10^{-7}	1.5×10^{-4}	3.9×10^{-5}	9.3×10^{-3}
Cd as cadmium oxide (CdO)	5.6×10^{-4}	Annual	2.6×10^{-7}	4.6×10^{-4}	1.6×10^{-5}	2.9×10^{-2}
Formaldehyde (HCOH)	7.7×10^{-2}	Annual	2.9×10^{-5}	3.8×10^{-4}	2.1×10^{-3}	2.7×10^{-2}
Nickel (Ni)	4.2×10^{-3}	Annual	2.3×10^{-7}	5.4×10^{-5}	1.4×10^{-5}	3.3×10^{-3}
Polycyclic aromatic compounds (PACs)[4]	3.0×10^{-4}	Annual	1.4×10^{-7}	4.8×10^{-4}	1.4×10^{-6}	4.5×10^{-3}

Source: INL 2013a

[1] From IDAPA 58.01.01.585 (non-carcinogens) and IDAPA 58.01.01.586 (carcinogens).

[2] New facility operational increase.

[3] New facility operational increase plus the INL baseline.

[4] Equivalent in potency to benzo(a)pyrene and include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, ibenzo(a,h)anthracene, chrysene.

Table 4.6-14: PSD Increment Consumption at Federal Class I and Class II Areas for the Transition Period of the New Facility Alternative

Pollutant[1]	Averaging Time	Allowable PSD Increment[2]	New Facility Operations Increment Consumed[3]	Ratio of PSD Increment Consumed to Allowable PSD Increment[4]	New Facility Operations Plus INL Baseline Increment Consumed	Ratio of PSD Increment Consumed to Allowable PSD Increment[5]
		micrograms per cubic meter			micrograms per cubic meter	
INL Federal Class II (Public Receptors)						
NO_2	Annual	$2.5{\times}10^{1}$	$6.0{\times}10^{-2}$	$2.4{\times}10^{-3}$	$7.0{\times}10^{-1}$	$2.8{\times}10^{-2}$
PM_{10}	24-hour	$3.0{\times}10^{1}$	$7.2{\times}10^{-2}$	$2.4{\times}10^{-3}$	2.0	$6.7{\times}10^{-2}$
	Annual	$1.7{\times}10^{1}$	$1.7{\times}10^{-3}$	$9.8{\times}10^{-5}$	$3.6{\times}10^{-2}$	$2.1{\times}10^{-3}$
$PM_{2.5}$	24-hour	9.0	$2.9{\times}10^{-2}$	$3.2{\times}10^{-3}$	$6.8{\times}10^{-1}$	$7.5{\times}10^{-2}$
	Annual	4.0	$1.4{\times}10^{-3}$	$3.4{\times}10^{-4}$	$3.6{\times}10^{-2}$	$9.0{\times}10^{-3}$
SO_2	3-hour	$5.12{\times}10^{2}$	$2.5{\times}10^{-2}$	$4.9{\times}10^{-5}$	$1.4{\times}10^{1}$	$2.7{\times}10^{-2}$
	24-hour	$9.1{\times}10^{1}$	$4.2{\times}10^{-3}$	$4.6{\times}10^{-5}$	2.1	$2.3{\times}10^{-2}$
	Annual	$2.0{\times}10^{1}$	$1.2{\times}10^{-4}$	$6.0{\times}10^{-6}$	$9.3{\times}10^{-3}$	$4.6{\times}10^{-4}$
Craters of the Moon National Monument Near Field Areas						
NO_2	Annual	2.5	$2.0{\times}10^{-3}$	$7.9{\times}10^{-4}$	$2.7{\times}10^{-2}$	$1.1{\times}10^{-2}$
PM_{10}	24-hour	8.0	$8.0{\times}10^{-4}$	$10.0{\times}10^{-4}$	$1.7{\times}10^{-2}$	$2.1{\times}10^{-3}$
	Annual	4.0	$3.4{\times}10^{-5}$	$8.5{\times}10^{-6}$	$4.9{\times}10^{-4}$	$1.2{\times}10^{-4}$
$PM_{2.5}$	24-hour	2.0	$4.5{\times}10^{-4}$	$2.2{\times}10^{-4}$	$1.1{\times}10^{-2}$	$5.4{\times}10^{-3}$
	Annual	1.0	$2.8{\times}10^{-5}$	$2.8{\times}10^{-5}$	$4.6{\times}10^{-4}$	$4.6{\times}10^{-4}$
SO_2	3-hour	$2.5{\times}10^{1}$	$3.2{\times}10^{-4}$	$1.3{\times}10^{-5}$	$8.8{\times}10^{-2}$	$3.5{\times}10^{-3}$
	24-hour	5.0	$5.7{\times}10^{-5}$	$1.1{\times}10^{-5}$	$1.3{\times}10^{-2}$	$2.7{\times}10^{-3}$
	Annual	2.0	$3.0{\times}10^{-6}$	$1.5{\times}10^{-6}$	$2.2{\times}10^{-4}$	$1.1{\times}10^{-4}$

Source: INL 2013a, INL 2013c

[1] NO_2 = nitrogen dioxide; PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; and SO_2 = sulfur dioxide.

[2] Source: 40 CFR 51.166(c)(I), Table for Federal Class I, II, and III.

[3] Increment consumed from new facility operations.

[4] New facility operational increase.

[5] New facility operational increase plus INL baseline.

Table 4.6-14: PSD Increment Consumption at Federal Class I and Class II Areas for the Transition Period of the New Facility Alternative (cont.)

Pollutant[1]	Averaging Time	Allowable PSD Increment[2]	New Facility Operations Increment Consumed[3]	Ratio of PSD Increment Consumed to Allowable PSD Increment[4]	New Facility Operations Plus INL Baseline Increment Consumed	Ratio of PSD Increment Consumed to Allowable PSD Increment[5]
		micrograms per cubic meter			micrograms per cubic meter	
Craters of the Moon National Monument Far Field Areas						
NO_2	Annual	2.5	2.2×10^{-3}	8.6×10^{-4}	1.6×10^{-2}	6.3×10^{-3}
PM_{10}	24-hour	8.0	3.2×10^{-3}	4.0×10^{-4}	2.0×10^{-2}	2.5×10^{-3}
	Annual	4.0	4.6×10^{-4}	1.1×10^{-4}	3.0×10^{-3}	7.5×10^{-4}
$PM_{2.5}$	24-hour	2.0	3.2×10^{-3}	1.6×10^{-3}	2.3×10^{-2}	1.1×10^{-2}
	Annual	1.0	5.0×10^{-4}	5.0×10^{-4}	3.6×10^{-3}	3.6×10^{-3}
SO_2	3-hour	2.5×10^{1}	4.0×10^{-4}	1.6×10^{-5}	8.5×10^{-3}	3.4×10^{-4}
	24-hour	5.0	1.2×10^{-4}	2.3×10^{-5}	2.3×10^{-3}	4.6×10^{-4}
	Annual	2.0	1.3×10^{-5}	6.7×10^{-6}	2.2×10^{-4}	1.1×10^{-4}
Yellowstone National Park						
NO_2	Annual	2.5	7.6×10^{-5}	3.1×10^{-5}	4.6×10^{-4}	1.9×10^{-4}
PM_{10}	24-hour	8.0	2.8×10^{-4}	3.5×10^{-5}	1.4×10^{-3}	1.7×10^{-4}
	Annual	4.0	2.6×10^{-5}	6.5×10^{-6}	1.7×10^{-4}	4.3×10^{-5}
$PM_{2.5}$	24-hour	2.0	4.0×10^{-4}	2.0×10^{-4}	2.3×10^{-3}	1.1×10^{-3}
	Annual	1.0	3.8×10^{-5}	3.8×10^{-5}	2.7×10^{-4}	2.7×10^{-4}
SO_2	3-hour	2.5×10^{1}	2.5×10^{-5}	1.0×10^{-6}	8.9×10^{-4}	3.5×10^{-5}
	24-hour	5.0	9.1×10^{-6}	1.8×10^{-6}	2.7×10^{-4}	5.3×10^{-5}
	Annual	2.0	6.8×10^{-7}	3.4×10^{-7}	1.8×10^{-5}	9.2×10^{-6}

Source: INL 2013a, INL 2013c
[1] PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; SO_2 = sulfur dioxide; and NO_2 = nitrogen dioxide.
[2] Source: 40 CFR 51.166(c)(I), Table for Federal Class I, II, and III.
[3] Increment consumed from new facility operations.
[4] New facility operational increase.
[5] New facility operational increase plus INL baseline.

Table 4.6-14: PSD Increment Consumption at Federal Class I and Class II Areas for the Transition Period of the New Facility Alternative (cont.)

Pollutant[1]	Averaging Time	Allowable PSD Increment[2]	New Facility Operations Increment Consumed[3]	Ratio of PSD Increment Consumed to Allowable PSD Increment[4]	New Facility Operations Plus INL Baseline Increment Consumed	Ratio of PSD Increment Consumed to Allowable PSD Increment[5]
		micrograms per cubic meter			micrograms per cubic meter	
Grand Teton National Park						
NO_2	Annual	2.5	3.9×10^{-5}	1.6×10^{-5}	2.4×10^{-4}	9.8×10^{-5}
PM_{10}	24-hour	8.0	2.1×10^{-4}	2.6×10^{-5}	1.1×10^{-3}	1.4×10^{-4}
	Annual	4.0	1.6×10^{-5}	4.0×10^{-6}	1.1×10^{-4}	2.7×10^{-5}
$PM_{2.5}$	24-hour	2.0	3.4×10^{-4}	1.7×10^{-4}	1.9×10^{-3}	9.4×10^{-4}
	Annual	1.0	2.4×10^{-5}	2.4×10^{-5}	1.7×10^{-4}	1.7×10^{-4}
SO_2	3-hour	2.5×10^{1}	2.2×10^{-5}	8.7×10^{-7}	5.8×10^{-4}	2.3×10^{-5}
	24-hour	5.0	4.4×10^{-6}	8.9×10^{-7}	1.7×10^{-4}	3.4×10^{-5}
	Annual	2.0	4.2×10^{-7}	2.1×10^{-7}	1.2×10^{-5}	5.8×10^{-6}

Source: INL 2013a, INL 2013c

[1] PM_{10} = particulate matter ≤10 micrometers; $PM_{2.5}$ = particulate matter ≤2.5 micrometers; SO_2 = sulfur dioxide; and NO_2 = nitrogen dioxide.

[2] Source: 40 CFR 51.166(c)(I), Table for Federal Class I, II, and III.

[3] Increment consumed from new facility operations.

[4] New facility operational increase.

[5] New facility operational increase plus INL Baseline.

Visibility at the Near Field Federal Class I Area (Craters of the Moon National Monument)

Visibility impacts from new facility operations at near field areas of the Craters of the Moon National Monument are provided in Table 4.6-15. Increases in ΔE and |C| are much less than established threshold values when modeled with emissions from other INL facilities (including the rest of NRF) indicating visibility would not be impaired. Therefore, impacts on visibility at Craters of the Moon National Monument from the transition period of the New Facility Alternative would be negligible.

Table 4.6-15: Visibility Impacts at Near Field Areas of Craters of the Moon National Monument During the Transition Period of the New Facility Alternative

Background	Theta	Azimuth	Distance		Alpha	ΔE[1] (Threshold Value = 2)	|C|[2] (Threshold Value = 0.05)
			kilometers	miles			
New Facility Operations Increase							
Sky	10	145	45.6	28.3	24	0.05	0
Sky	140	145	45.6	28.3	24	0.061	0.001
Terrain	10	84	32	19.9	84	0.082	0.001
Terrain	140	84	32	19.9	84	0.013	0
New Facility Operations Increase plus INL Baseline							
Sky	10	145	45.6	28.3	24	0.78	0.006
Sky	140	145	45.6	28.3	24	0.691	0.011
Terrain	10	84	32	19.9	84	0.418	0.003
Terrain	140	84	32	19.9	84	0.146	0.001

Source: INL 2013b

[1] Change in light extinction (i.e., absorption) caused mainly by the presence of NO_2 in the atmosphere when viewed against different backgrounds (e.g., sky and terrain). Screening values < 2 indicate ΔE would not be impacted.

[2] Absolute value of color contrast which represents impacts on blue light due to scattering from particulates in the atmosphere when viewed against different backgrounds. Screening values < 0.05 indicate color contrast would not be impacted.

Greenhouse Gases

For the estimates of GHG emissions for the new facility transition period, it is assumed that fuel oil-fired boilers would be used for heat, and purchased electricity from the grid would be used for the remaining power needs. Increases in GHG emissions for the transition period would be primarily from purchased electricity for facility operations (Scope 2), with a concurrent increase in transmission and distribution losses (Scope 3). Increased worker commuting would also result in an increase in Scope 3 emissions. Fuel oil for the boilers to heat the facility would be the main contributor to direct emissions (Scope 1), with a very small percentage from on-site wastewater treatment due to increased work force. The total increase in annual GHG emissions would not exceed 25,000 MT CO_2e, indicating additional analysis is not warranted. Based on these results, impacts of transition period activities on climate change would be negligible.

New federal facilities must comply with the Federal High Performance and Sustainable Building (HPSB) Guidance Requirements (Guiding Principles) (Executive Order (EO) 13693). Design and construction strategies would be developed to optimize energy performance for the New Facility Alternative. Since purchased electricity is the major contributor to GHGs for a new facility, any improvements on energy performance would function to reduce GHGs in this area. Use of refrigerants with a lower global warming potential and lower ozone depletion potential is an example of an improvement that would be used to reduce GHGs for a new facility.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only examination work continues in ECF. ECF would continue to be heated and require EDG testing to support the examination work. Since portions of the water pool would still be needed to support examination work, a conservative assumption is made that air pollutant emissions during the new facility operational period would be similar to the cumulative emissions described for the transition period. Therefore, criteria and TAP concentrations at receptor locations, PSD increment consumption at receptor locations, and visibility at Federal Class I areas, would be negligible as described cumulatively with the INL for the transition period of the New Facility Alternative. Impacts from GHG emissions would be similar to those described for the transition period of the New Facility Alternative.

4.6.2 Radiological Air Emissions and Impacts

The ROI for the radiological air quality analysis includes individuals within an 80.5-kilometer (50-mile) radius of NRF. This section presents a comparison of radiological air emissions for the proposed action and current ECF emissions. Details regarding NNPP control of airborne radioactivity are provided in Section 3.6.6.

Routine naval spent nuclear fuel handling operations result in very low levels of radiological emissions into the environment. The emissions are proportional to the tempo of shipping container unloading and naval spent nuclear fuel canister loading. These operations are primarily driven by the operating tempo of the naval nuclear fleet and the NNPP's obligations under SA 1995 and SAA 2008. The source of emissions from the unloading of shipping containers and loading of naval spent nuclear fuel canisters is primarily activated corrosion products. Although the corrosion products tightly adhere to the naval spent nuclear fuel, some corrosion products are shaken loose from the naval spent nuclear fuel during shipment or handling and become airborne when the shipping container is opened or the naval spent nuclear fuel canister is loaded.

The particulate airborne contamination from shipping container unloading and naval spent nuclear fuel canister loading is controlled at the source through HEPA filtered ventilation systems at the shipping container unloading stations and naval spent nuclear fuel canister loading stations. This significantly reduces the release of particulate contaminants to the work area in ECF and to the environment. In addition, facility design requirements stipulate confinement zones (DOE 2003c). The ventilation systems are designed to ensure air flows from areas of least expected contamination to areas of most expected contamination. This ventilation system design serves to help keep personnel exposure to radiological hazards as low as is reasonably achievable (ALARA).

As described in Section 3.6.6, ECF emissions for 2009 were selected to represent the emissions from routine naval spent nuclear fuel handling operations at the current ECF. These emissions are consistent with the emissions data from ECF for several prior years and would be consistent with emissions for years into the future. The development of source terms for routine naval spent nuclear fuel handling operations radiological emissions for the proposed action is discussed in Appendix F, Section F.4.1. The emissions rates are presented in units of Curies per year because these units are the most commonly used units for annual radiological emissions.

The radiation exposure based on the radiological air emission from routine naval spent nuclear fuel handling operations is discussed in Section 4.13.2. The radiation exposure to a member of the public from routine naval spent fuel operations is very low. Table 4.13-6 and Table 4.13-7 show that dose to the maximally exposed off-site individual is 6.0×10^{-9} Sievert (6.0×10^{-7} rem) which is 0.006 percent of the EPA annual dose limit of 10 millirem (40 C.F.R. § 61.102). Because radiological air emissions are low, it is unlikely that a National Emissions Standards for Hazardous Air Pollutants (NESHAP) permit to construct or modify would be needed for any of the alternatives.

4.6.2.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While naval spent nuclear fuel handling operations continue in ECF the need for preventative and corrective maintenance of the facility will increase. The ability to operate ECF in an environmentally responsible manner would impact the ability to operate at the pace necessary to comply with SA 1995, SAA 2008, and the operational tempo of the naval nuclear fleet. Also, the ability to unload M-290 shipping containers does not exist at ECF and the loading rates of naval spent nuclear fuel canisters would decrease from current loading rates.

If naval spent nuclear fuel handling operations cease at ECF, both shipping container unloading and navel spent nuclear fuel canister loading operations would no longer occur and there would be no radiological emissions from these operations.

Therefore, since the radiological emissions are related to the pace of operations, the radiological emissions from the No Action Alternative could decrease from those presented in Chapter 3. Therefore, there is no impact from radiological emissions from the No Action Alternative.

4.6.2.2 Overhaul Alternative

Refurbishment Period

During the 33-year refurbishment period of the Overhaul Alternative, naval spent nuclear fuel handling and examination operations would continue in ECF concurrent with refurbishment activities. The pace of operations would be reduced due to refurbishment. This reduced pace would result in a small reduction of radiological emissions from routine operations.

The refurbishment activities would involve handling hazardous and radiological materials as described in Section 4.13.2. These refurbishment activities could increase the airborne radiological emissions from ECF. The best management practices and controls described in Section 3.6.6 would minimize the spread of contamination to keep radiation exposures ALARA; therefore, the increase in radiological emissions would be small.

Overall the emissions from the refurbishment period would be similar to the emissions from ECF shown in Table 3.6-23. Therefore, there would be no impact on the environment from radiological emissions during the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

During the post-refurbishment operational period of the Overhaul Alternative, ECF would operate at maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters to meet the needs of the naval nuclear fleet and meet the terms of SA 1995 and SAA 2008.

The development of the radiological emissions for the post-refurbishment operational period is discussed in Appendix F, Section F.4.1. The radiological emissions for the post-refurbishment operational period are provided in Table 4.6-16.

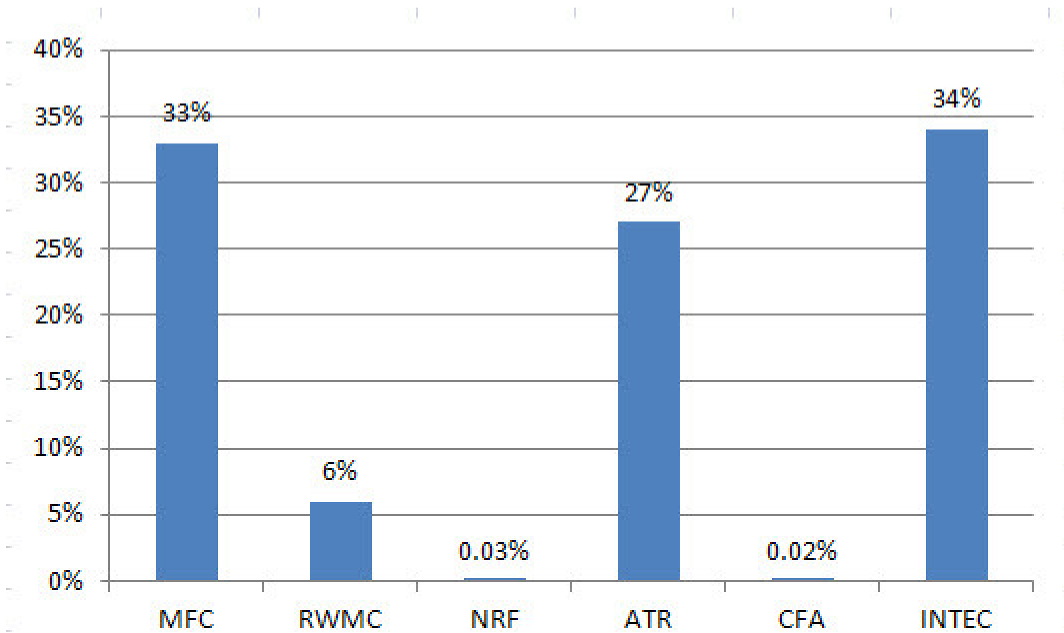
Table 4.6-16: Radiological Air Emissions for Routine Naval Spent Nuclear Fuel Handling Operations During the Post-Refurbishment Operational Period of the Overhaul Alternative

Radionuclide	Emissions	
	ECF Baseline	**Post-Refurbishment Operational Period**
	Curies per year	
^{14}C	8.0×10^{-1}	1.8
^{3}H	2.4×10^{-2}	5.8×10^{-2}
^{129}I	3.8×10^{-5}	3.6×10^{-5}
^{131}I	5.1×10^{-6}	7.6×10^{-6}
^{85}Kr	1.3×10^{-1}	1.3×10^{-1}
^{239}Pu[1]	6.7×10^{-7}	1.8×10^{-6}
^{90}Sr[2]	2.2×10^{-5}	5.7×10^{-5}
Total	**9.4×10^{-1}**	**1.9**

[1] Gross alpha activity is modeled as ^{239}Pu.
[2] Gross beta activity is modeled as ^{90}Sr.

In Table 4.6-16, the 2009 ECF baseline emissions (also presented in Table 3.6-23) are compared with the emissions from the post-refurbishment operational period of the Overhaul Alternative. This comparison shows the total emissions would increase. The small increase in radiological emissions is due entirely to the assumption that the facility would operate at maximum capacity following the refurbishment.

Although an increase in emissions results in a release of approximately 2 Curies per year, the increase is minimal when compared to the total radiological emissions from the INL. In 2009, INL emissions were over 7000 Curies (ESER 2010). The 2009 INL emissions are provided in Table 3.6-22 and the percentage of INL emissions from NRF are shown in Figure 3.6-4. (Section 3.6.5 for a discussion on INL emissions.) The percentage of INL emissions from NRF using the projected emissions from NRF during the post-refurbishment operational period are shown in Figure 4.6-2. Therefore, after accounting for the slight increase of emissions at NRF from the post-refurbishment operational period of the Overhaul Alternative, NRF emissions would represent less than 0.03 percent of INL emissions and would have a negligible impact on the environment. The impact of these radiological emissions on public and occupational health and safety is discussed in Section 4.13.2.1.



Source: ESER 2010

Figure 4.6-2: Facility Contributions to Total INL Airborne Radionuclide Releases During the Post-Refurbishment Operational Period of the Overhaul Alternative

4.6.2.3 New Facility Alternative

Construction Period

The construction period of the New Facility Alternative would not involve any radioactive materials and would not produce any radiological emissions. Therefore, there is no impact from radiological emissions during the construction period of the New Facility Alternative.

Transition Period

During the transition period of the New Facility Alternative, the new facility and ECF would operate in parallel to provide the maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters to meet the needs of the naval nuclear fleet and meet the terms of SA 1995 and SAA 2008. Therefore, during this period both ECF and the new facility would be sources for radiological emissions from naval spent nuclear fuel handling operations; and ECF would also continue to be a source of radiological emissions from examination operations.

The development of the radiological emissions for the transition period is discussed in Appendix F, Section F.4.1. The radiological emissions for the transition period are provided in Table 4.6-17.

Table 4.6-17: Radiological Air Emissions for Routine Naval Spent Nuclear Fuel Handling Operations During the Transition Period of the New Facility Alternative

Radionuclide	Emissions	
	ECF Baseline	Transition Period (ECF and the New Facility)
	Curies per year	
^{14}C	8.0 x 10^{-1}	1.8
^{3}H	2.4 x 10^{-2}	5.8 x 10^{-2}
^{129}I	3.8 x 10^{-5}	3.6 x 10^{-5}
^{131}I	5.1 x 10^{-6}	7.6 x 10^{-6}
^{85}Kr	1.3 x 10^{-1}	1.3 x 10^{-1}
^{239}Pu[1]	6.7 x 10^{-7}	1.8 x 10^{-6}
^{90}Sr[2]	2.2 x 10^{-5}	5.7 x 10^{-5}
Total	**9.4 x 10^{-1}**	**1.9**

[1] Gross alpha activity is modeled as ^{239}Pu.
[2] Gross beta activity is modeled as ^{90}Sr .

In Table 4.6-17, the 2009 ECF baseline emissions (also presented in Table 3.6-23) are compared with the emissions from the transition period of the New Facility Alternative. This comparison shows the total emissions would increase. The small increase in radiological emissions is due entirely to the assumption that ECF and the new facility would operate in parallel at maximum capacity during the transition period.

Although an increase in emissions results in a release of approximately 2 Curies per year, the increase is minimal when compared to the total radiological emissions from the INL. In 2009, INL emissions were over 7000 Curies (ESER 2010). The 2009 INL emissions are provided in Table 3.6-22 and the percentage of INL emissions from NRF are shown in Figure 3.6-4. (Section 3.6.5 for a discussion on INL emissions.) The percentage of INL emissions from NRF using the projected emissions from NRF during the transition period would be the same as those shown in Figure 4.6-2. Therefore, after accounting for the slight increase of emissions at NRF from the transition period of the New Facility Alternative, NRF emissions would represent less than 0.03 percent of INL emissions and would have a negligible impact on the environment. The impact of these radiological emissions on public and occupational health and safety is discussed in Section 4.13.2.1.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and naval spent nuclear fuel examination work continues in ECF. During this period, the radiological emissions would be the same as during the transition period (Table 4.6-17). The only difference is that the new facility would be the sole source of the radiological emissions for all naval spent nuclear fuel handling operations and ECF would continue to contribute emissions from examination operations. The increase in radiological emissions from the 2009 ECF baseline emission is due entirely to the assumption that the new facility would operate at maximum capacity.

Although an increase in emissions results in a release of approximately 2 Curies per year, the increase is minimal when compared to the total radiological emissions from the INL. In 2009, INL emissions were over 7000 Curies (ESER 2010). The 2009 INL emissions are provided in

Table 3.6-22 and the percentage of INL emissions from NRF are shown in Figure 3.6-4. (Section 3.6.5 for a discussion on INL emissions.) The percentage of INL emissions from NRF using the projected emission from NRF during the new facility operational period would be the same as those shown in Figure 4.6-2. Therefore, after accounting for the slight increase of emissions at NRF from the new facility operational period of the New Facility Alternative, NRF emissions would represent less than 0.03 percent of INL emissions and would have a negligible impact on the environment. The impact of these radiological emissions on public and occupational health and safety is discussed in Section 4.13.2.1.

4.7 Noise

This section describes the potential noise impacts from the alternatives. The ROI for noise generated at NRF includes INL and the closest site boundary to NRF (10.5 kilometers (6.5 miles) west northwest from the center point of NRF). Noise at NRF is characteristic of an industrial environment. Trucks, automobiles, cranes, engine-powered equipment, boiler testing, steam venting, and operating transmission lines are examples of noise sources at NRF.

Noise from proposed activities such as refurbishment, construction, and operating equipment would be measured in terms of dBA. Noise ranging from 80 to 95 dBA can be heard at a distance of 15 meters (50 feet) from the source (NRC 2011). The closest possible member of the public (a residence that is occupied year-round) is located at a distance of 13.7 kilometers (8.5 miles) from NRF (DOE 2011e). Additionally, there are no other public and sensitive receptors (i.e., church or school) within 13.7 kilometers (8.5 miles) of NRF. Therefore, noise levels significantly higher than 95 dBA would be necessary to affect an off-site receptor.

Workers at NRF would follow the current hearing protection requirements discussed in Section 3.7. The occupational non-radiological health and safety impacts from noise are addressed in Section 4.13.1.

4.7.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While ECF operations continue, no changes to noise levels at NRF described in Section 3.7 would occur. If ECF operations cease, there could be a decrease in noise levels at NRF. Therefore, there would be no impact to public and sensitive receptors or wildlife from the No Action Alternative.

4.7.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. Temporary increases in noise could result from the refurbishment period of the Overhaul Alternative. Refurbishment efforts for the water pools may include actions such as installing liners and would include reinforcing areas of known structural degradation. Noise levels for structural steel work, refurbishment, and repair would be between 95-130 dBA and would be localized in ECF. The noise level would be dependent on where the measurement is taken. For example, in the case of concrete cutting or the use of a jackhammer, the noise levels recorded would be around 130 dBA if the noise measurement is collected at the source. However, if the noise measurement is collected away from where the concrete cutting or use of a jackhammer occurs, the recorded noise level would be between 95-100 dBA.

Construction of a new security boundary system would also take place during the refurbishment period and would be expected to last 1 year. Noise generation for constructing a new security boundary system would include heavy equipment traffic, augers, and friction saws, and would range from an estimated 85 to 90 dBA. Noise ranging from 80 to 95 dBA can be heard at a distance of 15 meters (50 feet) from the source (NRC 2011). The noise produced at NRF, and the hearing protection required, is managed in accordance with internal safety requirements based on Occupational Safety and Health Administration (OSHA) regulations, with noise limits set by the American Conference of Governmental Industrial Hygienists. Site Safety-approved hearing protection is required for workers when noise levels reach and exceed 85 dBA. Double hearing protection (ear plugs and earmuffs) is required in areas where the noise level reaches and exceeds 100 dBA. Due to the distance of public receptors, noise generated would have no impact on public and sensitive receptors during the refurbishment period of the Overhaul Alternative.

Wildlife in nearby habitats could be disturbed by the increased noise levels during construction of the new security boundary system and could potentially move farther away in the surrounding sagebrush steppe habitat. Previous studies on effects of noise on wildlife indicate that even high intermittent noise levels at INL (more than 100 dBA) would not affect wildlife productivity (NRC 2004). Impacts to wildlife during the refurbishment period of the Overhaul Alternative are provided in Section 4.5.2.

Noise could increase along U.S. Highway 20, U.S. Highway 26, and State Route 33 during the refurbishment period due to traffic increases from deliveries and the commuting refurbishment workforce. Noise measurement data obtained from locations within 15 meters (50 feet) of U.S. Highway 20 showed traffic noise ranged from 64 to 86 dBA, with buses identified as the primary source, contributing from 71 to 80 dBA (NRC 2011). The increase in traffic during the refurbishment period provided in Section 4.2.2 would be small; therefore, the increase in noise would be negligible to the public and sensitive receptors located along U.S. Highway 20, U.S. Highway 26, and State Route 33 during the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. Noise levels during the post-refurbishment operational period of the Overhaul Alternative would not change from the current noise levels at NRF described in Section 3.7. There would be no impact to the public and sensitive receptors or wildlife from noise during the post-refurbishment operational period of the Overhaul Alternative.

4.7.3 New Facility Alternative

Construction Period

The duration of the construction activities for the New Facility Alternative would be approximately 3 years and would occur in parallel with ECF operations. The impacts to the public and sensitive receptors from noise during construction activities of the New Facility Alternative are presented in this section in terms of changes to the noise environment established for NRF in Section 3.7. The evaluation of noise impacts does not vary between Location 3/4 and Location 6; therefore, a single impact evaluation applicable to both locations is provided below.

During the construction period for the New Facility Alternative, the majority of the construction vehicles and equipment would operate within the area of disturbance (Figures 4.1-2 and 4.1-3). Noise from the operation of heavy equipment, to include bulldozers, compactors, and dump trucks would range from an estimated 80 to 100 dBA measured at 15 meters (50 feet) from the activity. New facility construction activities would involve the construction of a new security boundary system and permanent buildings. Noise generation for constructing a new security boundary system would include heavy equipment traffic, augers, and friction saws and would range from an estimated 85-90 dBA measured at 15 meters (50 feet) from the activity. The noise produced at NRF, and the hearing protection required, is managed in accordance with internal safety requirements based on OSHA regulations, with noise limits set by the American Conference of Governmental Industrial

Hygienists. Site Safety-approved hearing protection is required for workers when noise levels reach and exceed 85 dBA. Double hearing protection (ear plugs and earmuffs) is required in areas where the noise level reaches and exceeds 100 dBA. Due to the distance of public receptors, noise generated due to the construction of a new facility would have no impact on public and sensitive receptors during the construction period of the New Facility Alternative.

Wildlife in nearby habitats could be disturbed by the increased noise levels during the construction period of the New Facility Alternative and could potentially move farther away in the surrounding sagebrush steppe habitat. Previous studies on effects of noise on wildlife indicate that even high intermittent noise levels at the INL (more than 100 dBA) would not affect wildlife productivity (NRC 2004). Impacts to wildlife during the construction period of the New Facility Alternative are discussed further in Section 4.5.3.

Noise could increase along U.S. Highway 20, U.S. Highway 26, and State Route 33 during construction of the new facility due to traffic increases from deliveries and the commuting construction workforce. Noise measurement data obtained from locations within 15 meters (50 feet) of U.S. Highway 20 showed traffic noise ranged from 64 to 86 dBA, with buses identified as the primary source, contributing from 71 to 80 dBA (NRC 2011). The increase in traffic during the construction period of the New Facility Alternative provided in Section 4.2.3 would be small; therefore, the increase in noise would be negligible to the public and sensitive receptors located along U.S. Highway 20, U.S. Highway 26, and State Route 33 during the construction period of the New Facility Alternative.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. Expected noise levels for the transition period would not change from current recorded levels at NRF described in Section 3.7. Impacts to wildlife for the transition period are discussed further in Section 4.5.3. There would be no impact to the public and sensitive receptors from noise sources or levels for the transition period of the New Facility Alternative.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only naval spent nuclear fuel and irradiation test specimen examination work continues in ECF. Expected noise levels for the operational period would not change from current recorded levels at NRF described in Section 3.7. Impacts to wildlife during the new facility operational period would not change from those described for the transition period of the New Facility Alternative and are discussed further in Section 4.5.3. There would be no impact to the public and sensitive receptors from noise sources or levels for the new facility operational period.

4.8 Cultural and Historic Resources

This section describes the potential impacts on cultural resources and historic properties from the proposed action. The ROI for cultural and historic resource impact evaluations is NRF.

The National Historic Preservation Act (NHPA) of 1966, as amended, requires that all adverse effects to National Register for Historic Places (NRHP) eligible cultural resources and historic properties be considered during federal undertakings, such as the proposed action. A resource is considered eligible for listing on the NRHP by meeting at least one of the following criteria (36 C.F.R. § 60.4):

1. Association with a historic person
2. Association with a historic event
3. Representation of the work of a master craftsman
4. Potential to provide information on the history or prehistory of the U.S.

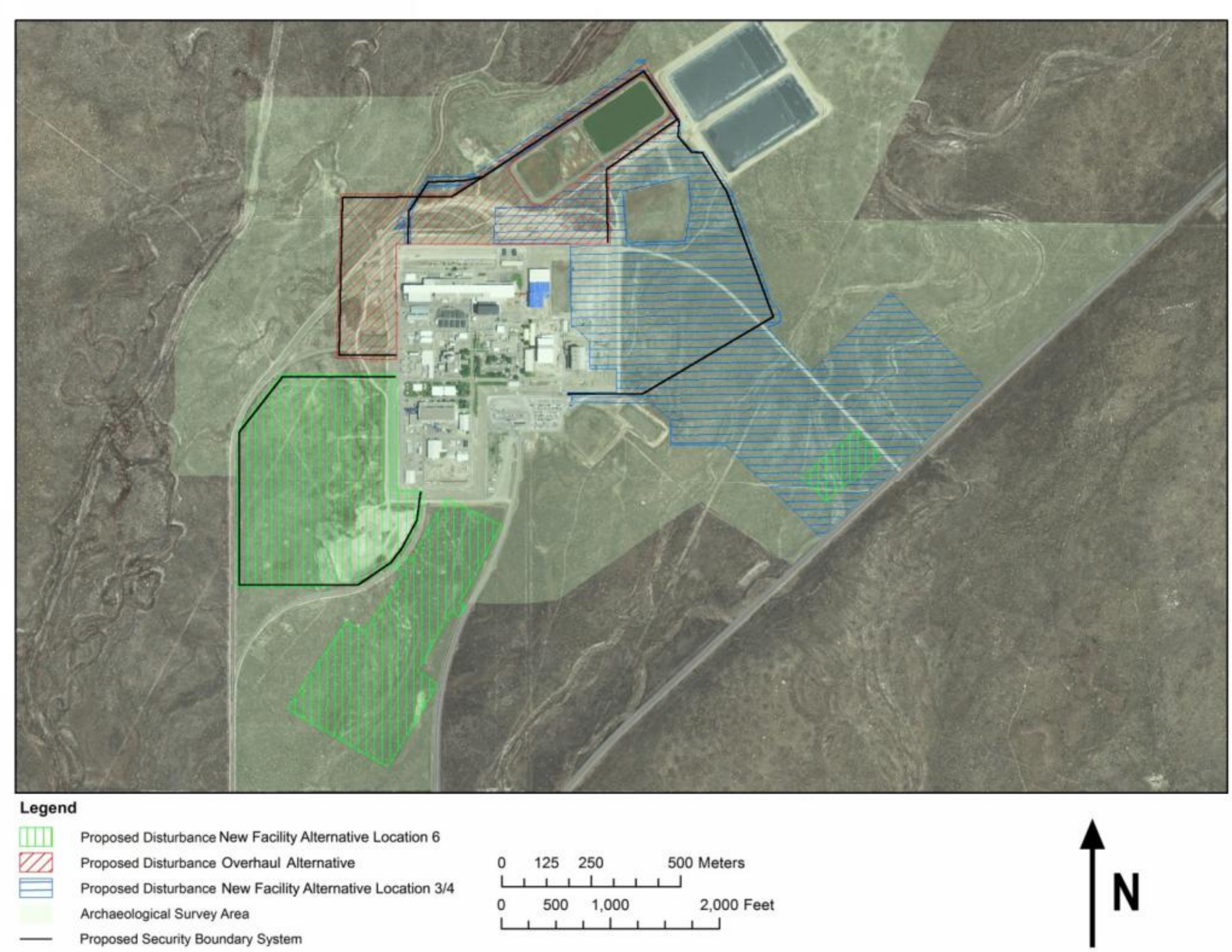
As described in Section 3.8.3, Experimental Breeder Reactor (EBR)-1 is the only INL resource listed on the NRHP and is a national historic landmark. There are no buildings listed on the NRHP at NRF. Further, none of the actions proposed in this EIS would disturb any buildings; therefore, the analysis in this section is primarily focused on cultural resources. Section 106 of the NHPA identifies the process for considering whether a project would affect significant cultural resources. The Section 106 process requires consultation between the lead federal agency and the State Historic Preservation Office (SHPO), which is the custodian of information on cultural resources for the State. The Section 106 process also requires that federally recognized Native American groups who have ancestral interest in the resource should be consulted to determine if resources important to the tribe are present (36 C.F.R. § 800.2(4)(c)(ii)). For the proposed action, Section 106 consultations were conducted between NNPP and the Idaho SHPO and between NNPP and the Shoshone-Bannock Tribes (Appendix B).

This analysis addresses the potential impacts to NRHP eligible resources located within the boundaries of NRF. Activities were reviewed to identify those that would cause ground disturbance, introduce visual changes, or make changes to existing buildings and structures. The alternatives are analyzed to determine if they would cause adverse effects to NRHP eligible resources. Adverse effects include, but are not limited to:

1. Physical destruction, damage, or alteration of all or part of the resource
2. Isolation of the resource or alteration of the character of the resource's setting when that character contributes to the resource's qualifications for the NRHP
3. Introduction of visual, audible, or atmospheric elements that are out of character with the resource, or changes that alter its setting
4. Neglect of a resource resulting in its deterioration or destruction
5. Transfer, lease, or sale of a resource without adequate provision to protect the resource's historic integrity

Impacts to cultural or historic resources would occur if the proposed action disturbed cultural resources or historic properties.

The potential sites for the proposed action were surveyed for the presence of cultural resources or historic properties in 2011 and 2012. The first report was prepared based on surveys conducted in 2011 (INL 2011b). A second report was prepared documenting additional investigations and some additional survey work completed in 2012 (INL 2013d) based on facility realignment, a new security boundary system, and additional rail line options developed during conceptual design. Based on the survey information, disturbance areas would be located to minimize impacts to cultural resources. Figure 4.8-1 shows the survey areas and potential disturbance areas the alternatives. Table D-1 in Appendix D provides a summary of the archaeological resources in the survey area.



Source: INL 2013d

Figure 4.8-1: Land Disturbance and Archaeological Survey Coverage

4.8.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

Under this alternative, there would be no ground disturbance, visual changes, or culturally or historically significant changes made to ECF. Therefore, there would be no impact on cultural resources or historic properties from the No Action Alternative.

4.8.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. As described in Section 4.1.2, the majority of land disturbance during the refurbishment period for the Overhaul Alternative would be from the construction of a new security boundary system. There would be no impact to cultural resources or historic properties because there are no cultural resources or historic properties located in the disturbance area shown in Figure 4.8-1 for the Overhaul Alternative. The archaeological investigations support a finding of no impact to cultural resources or historic properties for the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. The post-refurbishment operational period would not require land disturbance or development. Therefore, there would be no impact to cultural resources or historic properties during the post-refurbishment operational period of the Overhaul Alternative.

4.8.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period.

The disturbance areas for Location 3/4 and Location 6 for the New Facility Alternative are shown on Figure 4.8-1

Fifteen archaeological resources were identified within the New Facility Alternative Location 3/4 disturbance area. These include one lithic scatter, ten isolate locations, and four campsites. All of the archaeological resources identified in the Location 3/4 disturbance area are ineligible for nomination to the NRHP due to limited research potential and lack of integrity.

Four archaeological resources were identified within the New Facility Alternative Location 6 disturbance area. These include one lithic scatter and three isolate locations. All of the archaeological resources identified in Location 6 disturbance area are ineligible for nomination to the NRHP due to limited research potential and lack of integrity.

A report describing the 2013 surveys and additional subsurface investigations was provided to the SHPO and the Shoshone-Bannock Tribes (INL 2013d). The SHPO concurred that there would be no adverse effect to historic properties eligible for listing on the NRHP (Appendix B). Even though the small archaeological sites that have been identified are not eligible for the NRHP, the historical record described in the INL Cultural Resources Management Plan supports the conclusion that INL, including the proposed disturbance areas, is located within a large original territory of the Shoshone-Bannock people and archaeological and other cultural resources that reflect the importance of the area to the Tribes are located there. The Shoshone-Bannock Tribes agreed that the construction of the new facility at NRF would have small unavoidable impacts to Native American cultural resources (small archaeological sites and ecological resources) identified in the survey areas for Location 3/4 and Location 6 and indicated their general support for the proposed action (Appendix B).

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. The transition period of the New Facility Alternative would not require land disturbance or development. Therefore, there would be no impact to cultural resources or historic properties from the transition period.

New Facility Operational Period

The New Facility Operation Period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only naval spent nuclear fuel and irradiation test specimen examination work continues in ECF. The new facility operational period would not require land disturbance or development. Therefore, there would be no impact to cultural resources or historic properties from the new facility operational period.

4.9 Visual and Scenic Impacts

This section discusses the potential visual and scenic impacts from the alternatives. The ROI for visual and scenic resources includes INL; the Eastern Snake River Plain; Fort Hall Reservation; the Bitterroot, Lemhi, and Lost River mountain ranges; the Big Southern Butte; East Butte; Middle Butte; Circular Butte; Antelope Butte; and Class I areas evaluated for visibility impacts from air emissions (Grand Teton National Park, Yellowstone National Park, and Craters of the Moon National Monument). The proposed action would cause visual and scenic impacts if the alternatives introduced deterioration or contrasts to the visual landscape.

Visibility has been specifically designated as an air quality-related value under the 1977 Prevention of Significant Deterioration Amendments to the Clean Air Act. Visibility impacts related to air quality were initially screened for Grand Teton National Park, Yellowstone National Park, and Craters of the Moon National Monument (Section 3.6.3.4). The results of the screening for the National Parks and analysis for Craters of the Moon National Monument are provided in Section 4.6.1.1.

The Bureau of Land Management (BLM) has developed a Visual Resource Management (VRM) system for use in evaluation of visual resources on its lands. The BLM's VRM system is officially applicable only to BLM land, but it provides a useful tool for inventorying and managing visual resources. There are four levels of VRM rating, designated as VRM Classes I to IV, with Class I being the most restrictive and protective of the visual landscape and Class IV being the least restrictive (Section 3.9 for details). The visual resource impact discussion that follows relies on the terminology and concepts from the BLM VRM system.

4.9.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

Under the No Action Alternative, there would be no impact on visual and scenic resources from landscape contrast since no new structures would be built.

4.9.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. No buildings or other large structures would be added to ECF during the refurbishment period of the Overhaul Alternative. Construction of a new security boundary system would take place outside of ECF (Figure 4.11-1), but this system would be at ground level and would not be visible from surrounding areas. Emissions during the refurbishment period of the Overhaul Alternative would not cause an increase in visibility impacts over the baseline provided in Section 3.6.3.4 and are less than the established threshold values. Impacts to visibility during the refurbishment period of the Overhaul Alternative are provided in Section 4.6.1.4. There would be no impact to visual and scenic resources from landscape contrast during the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. There would be no impact to visual and scenic resources from landscape contrast during the post-refurbishment operational period of the Overhaul Alternative since no new structures would be built. Emissions during the post-refurbishment operational period of the Overhaul Alternative would not cause an increase in visibility impacts over the baseline provided in Section 3.6.3.4 and are less than the established threshold values. Impacts to visibility during the post-refurbishment operational period of the Overhaul Alternative are provided in Section 4.6.1.4.

4.9.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. Construction activities would be concentrated adjacent to existing facilities and already developed areas. New facility construction activities would involve the construction of a new security boundary system and permanent buildings. These permanent facilities associated with naval spent nuclear fuel handling operations would be consistent with the current visual character of NRF. Impacts during the 3-year construction period of the New Facility Alternative would be the same at either Location 3/4 or Location 6. Emissions during the construction period of the New Facility Alternative would increase over the baseline provided in Section 3.6.3.4 but are much less than the established threshold values. Impacts to visibility during the construction period of the New Facility Alternative are provided in Section 4.6.1.5.

The new facility would be approximately 30 meters (100 feet) tall. The CSRF and the Spent Fuel Packaging facility are both approximately 30 meters (100 feet) tall. Therefore, the new facility would be approximately the same height as the tallest existing facility at NRF. These facilities can be seen from the Big Southern Butte, which is occasionally used for recreation; however, NRF is greater than 30 kilometers (18 miles) from the butte. Since the new facility is consistent with the current visual character of NRF, there would be no impact to visual and scenic resources from landscape contrast during the construction period of the New Facility Alternative.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. There would be no impact to visual and scenic resources from landscape contrast during the transition period of the New Facility Alternative since no new structures would be built. Emissions during the transition period of the New Facility Alternative would increase over the baseline provided in Section 3.6.3.4 but are much less than established threshold values. Impacts to visibility during the transition period of the New Facility Alternative are provided in Section 4.6.1.5.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only naval spent nuclear fuel and irradiation test specimen examination work continues in ECF. There would be no impact to visual and scenic resources from landscape contrast during the new facility operational period since no new structures would be built. Emissions during the new facility operational period would increase over the baseline provided in Section 3.6.3.4 but are much less than established threshold values. Impacts to visibility during the new facility operational period of the New Facility Alternative are provided in Section 4.6.1.5.

4.10 Socioeconomics

This section discusses the potential impacts from the alternatives to the socioeconomics of the seven-county ROI associated with INL: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison counties. Also included are the Fort Hall Reservation and the Trust Lands, home of the Shoshone-Bannock Tribes, which lie largely within Bingham and Bannock counties. Impacts for socioeconomics were evaluated for the ROI population in terms of jobs, incomes, revenues to local and state governments, housing, and changes in public service levels. The proposed action is consistent with the type of employment on INL and does not result in a significant change to local or regional economics; therefore, potential impacts for change in industry and change in economic characteristics are not evaluated below. Information and methodology used in the impact evaluations are described below.

Direct and Indirect Employment

NRF manpower estimates show some small fluctuations over time due to differences in yearly schedules for processing shipping containers, loading naval spent nuclear fuel canisters, performing naval spent nuclear fuel examinations, and facility maintenance needs. In the discussion of the alternatives, the total change in the number of NRF workers for the time period is provided along with the difference in the number of naval spent nuclear fuel handling workers attributable to the proposed action. The total change in the number of NRF workers is provided for use in system capacity impact evaluations (e.g., in Section 4.4) while the difference in the number of naval spent nuclear fuel handling workers attributable to the proposed action is applicable to most other impact analysis, including the socioeconomic impact analysis provided in this section.

Employment impacts are estimated by evaluating both the direct and indirect impacts. Direct impacts are jobs and income that result directly from the proposed action (e.g., creation of a construction job). Indirect impacts are jobs and income created in the community as a result of the direct impacts created by the proposed action. The number of direct jobs created for construction or refurbishment (construction jobs) and direct jobs for the post-refurbishment, transition and new facility operational periods (naval spent nuclear fuel handling jobs) are estimated on an annual basis for each alternative. Indirect employment and indirect income levels are estimated on an annual basis for each alternative using economic multipliers from the Regional Input-Output Modeling System-II developed by the U.S. Bureau of Economic Analysis (BEA 2011).

Taxes

State income tax revenue impacts are approximated by applying the Idaho income tax rate of 7.8 percent (Idaho 2010) to a weighted-average salary determined by the number and types of construction and naval spent nuclear fuel handling workers. State and local sales tax revenues are calculated by estimating the after-tax (federal and state) income that could be spent by construction and naval spent nuclear fuel handling workers within the ROI. The state and local sales tax revenues (6 percent sales tax rate (Idaho 2010)) are taken on the after-tax earnings after accounting for home ownership (assuming a deduction of $12,000 per year mortgage from the after-tax income) and a deduction of an additional 20 percent to account for income that may not be spent within the ROI. Property taxes are assumed to be at the urban rate of 1.275 percent (Idaho 2010); this rate is applied to 90 percent of the direct employees consistent with the percentage of INL employees who currently own their own home (INL 2010b).

Non-Local Labor

Impacts to the population size, housing, community services, and schools from labor increases are estimated with assumptions for non-local labor (from anywhere outside of the seven-county ROI). For the construction and refurbishment periods of the proposed action, it is assumed that 97 percent of the workers would be local (from the seven-county ROI) and 3 percent would be non-local. For the naval spent nuclear fuel handling workforce, it is assumed that 30 percent of the workers would be local and 70 percent would be non-local. These estimates are based upon recent NRF data. The assumptions for non-local labor are used to calculate in-migration to the ROI using the Idaho average family size of 3.16 persons (obtained by dividing the number of people in families by the total number of families) (USCB 2012b). It is estimated that 65 percent of new employees would bring one spouse and one school-aged child into the area (NRC 2011). Indirect workers are assumed to come from available labor within the ROI.

Housing

Incremental impacts to housing are estimated by comparing estimated population migration into the vacant and available housing within the ROI using vacant housing levels of 8400 units in the ROI (USCB 2012b). Impacts to housing are conservatively estimated by assuming that each newly employed worker from outside of the ROI would require his or her own housing. Because there is no housing shortage and an abundance of available rental housing units within the ROI, an increase in the amount of housing occupied by workers is viewed as a beneficial impact.

Community Services

Incremental impacts to community and social services are assessed by estimating the increase in population from the proposed action and the number of additional local community service employees that would be required to maintain existing levels of service for education, law enforcement, and fire protection.

4.10.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While operations in ECF continue, employment would be expected to remain at current levels because the reductions in the number of naval spent nuclear fuel handling workers from operational impacts resulting in work stoppages would be offset by the increase in the number of workers needed for maintenance activities to support the aging facilities and supporting infrastructure. Therefore, there would be no impact to levels of employment, income, and tax revenues or the socioeconomic characteristics of the ROI as described in Section 3.10.

If ECF operations cease, there would be a decrease in the number of workers and small impacts to levels of employment, income, and tax revenues or the socioeconomic characteristics of the ROI as described in Section 3.10.

4.10.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. An average of 180 direct construction jobs and 220 indirect jobs in the community would be created, providing a small beneficial impact. There would be no change to the number of naval spent nuclear fuel handling workers required during the refurbishment period.

Socioeconomic impacts from the refurbishment period of the Overhaul Alternative are presented in Table 4.10-1.

Table 4.10-1: Socioeconomic Impacts for the Refurbishment Period of the Overhaul Alternative

Parameter	Annual Impacts
Number of Jobs[1]:	
Direct	180
Indirect	220
Total	400
Income[2] ($ millions per year):	
Direct	22.7
Indirect	28.5
Total	51.2
Tax Revenues[2] ($ millions per year):	
State Income Taxes	4.0
Sales and Use Taxes	1.5
Property Taxes	0.4
Total	5.9
New ROI Residents	10
Housing Units Required	10
Public Service (number of new employees):	
Police Officers	<1
Firefighters	<1
Teachers	<1

[1]Represents the average refurbishment workforce during the 33-year refurbishment period.
[2]2011 dollars (includes direct and indirect jobs).
Note: Multiplier for jobs is 1.2420; multiplier for income is 1.2559 (BEA 2011).

There would be a negligible impact from the 33-year population increase of about 10 people resulting from the increase of 180 construction jobs during the refurbishment period. This is a population increase of less than 0.01 percent to the ROI. This population increase is attributable to a small influx of non-local labor. Similarly, there would be a negligible impact during the refurbishment period from the increase in occupation of vacant housing of 0.06 percent from this population increase.

The total estimated income and tax revenues created by direct and indirect jobs are addressed in Table 4.10-1. Three percent of the construction workforce is assumed to be non-local and would move into the ROI increasing income and tax revenue; therefore, there would be small annual beneficial impacts to local and state revenues from INL personnel income, sales, and property taxes of approximately $6 million during the refurbishment period of the Overhaul Alternative.

Less than one additional teacher, firefighter, and police officer would be required to maintain current levels of service. Therefore, there would be a negligible impact to public service levels from the refurbishment period of the Overhaul Alternative.

With the exception of the increase in employment from the 180 construction jobs, NRF employment levels would be expected to remain at current levels during the 33-year refurbishment period. Naval spent nuclear fuel handling workers impacted by refurbishment activities, such as work stoppages or slowdowns, would be reassigned to activities related to the refurbishment project.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment when naval spent nuclear fuel handling activities would take place in ECF.

As described in Chapter 2 for the Overhaul Alternative, there would be impacts to the efficiency of ECF during refurbishment. During the post-refurbishment period, ECF would meet the demands of the fleet and the NNPP's obligations under SA 1995 and SAA 2008. Approximately 80 additional direct naval spent nuclear fuel handling jobs would be created to catch up on work delayed during the refurbishment period, providing a small beneficial impact. This beneficial impact would last for the 12-year duration of the post-refurbishment operational period. Of the 80 additional naval spent nuclear fuel handling workers, 70 percent would come from outside the ROI (non-local) based on current NRF workforce data. Assuming all indirect labor is local, there would be an increase of 130 people in the ROI, or approximately 0.04 percent, resulting in a negligible impact to the ROI population. Impacts from the post-refurbishment operational period for the Overhaul Alternative are presented in Table 4.10-2.

Table 4.10-2: Socioeconomic Impacts for the Post-Refurbishment Operational Period of the Overhaul Alternative

Parameter	Annual Impacts
Number of Jobs:	
Direct	80
Indirect	140
Total	220
Income[1] ($ millions per year):	
Direct	10.0
Indirect	16.0
Total	26.0
Tax Revenues[1] ($ millions per year):	
State Income Taxes	2.0
Sales and Use Taxes	0.8
Property Taxes	0.2
Total	3.0
New ROI Residents	130
Housing Units Required	60
Public Service (number of new employees):	
Police Officers	<1
Firefighters	<1
Teachers	2

[1]2011 dollars (includes direct and indirect jobs).
Note: Multiplier for jobs is 1.7956; multiplier for income is 1.5951 (BEA 2011).

The additional 80 direct naval spent nuclear fuel handling workers would result in an increase to INL employment of about 1.0 percent, and an increase to NRF employment of approximately 5.8 percent. The population increase would result in a negligible impact from a decrease of approximately 0.7 percent of the available vacant housing. There would be a small beneficial impact from the income and tax revenues created by direct and indirect jobs during the post-refurbishment operational period. Direct income from INL employment would increase by approximately 1.5 percent of the total INL income. There would be small annual beneficial impacts to local and state revenues from an increase in INL personnel income, sales, and property taxes of approximately $3 million.

Two additional teachers, and less than one additional police officer and firefighter would be required to maintain current levels of service. Therefore, there would be a small impact to public service levels from the post-refurbishment operational period of the Overhaul Alternative.

Total employment numbers at NRF would fluctuate during the post-refurbishment operational period due to activities unrelated to the proposed action (e.g., performing naval spent nuclear fuel examinations and facility maintenance needs). Since NRF employment unrelated to the proposed action is projected to decrease during this period, the total increase in NRF employment during the post-refurbishment operational period would be about 50 workers.

4.10.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts from construction activities of the proposed action are presented below in terms of increases to the baseline employment established in Section 3.10.

Approximately 360 direct construction jobs and 450 indirect jobs would be created and last through the assumed 3-year construction period for the New Facility Alternative, creating a small beneficial impact to employment. Assuming that all 450 indirect jobs created in the community would be filled by the local population and that non-local construction labor would be only 3 percent of the construction workforce, there would be an increase of 30 people in the ROI, or approximately 0.01 percent, resulting in a negligible impact from an increase in the ROI population. Impacts to the socioeconomic environment from the construction of a new facility are shown in Table 4.10-3.

Table 4.10-3: Socioeconomic Impacts for the Construction Period of the New Facility Alternative

Parameter	Annual Impacts
Number of Jobs:[1]	
Direct	360
Indirect	450
Total	810
Income[2] **($ millions per year):**	
Direct	29.2
Indirect	36.6
Total	65.8
Tax Revenues[2] **($ millions per year):**	
State Income Taxes	5.1
Sales and Use Taxes	2.9
Property Taxes	0.8
Total	8.8
New ROI Residents	30
Housing Units Required	10
Public Service (number of new employees):	
Police Officers	<1
Firefighters	<1
Teachers	<1

[1]Represents the average number of construction jobs available per year over the 3-year construction period.
[2]2011 dollars (includes direct and indirect jobs).
Note: Multiplier for jobs is 1.2420; multiplier for income is 1.2559 (BEA 2011).

The population increase is expected to result in an increase in occupation of vacant housing of 0.1 percent, causing a negligible impact to vacancies from the construction period of the New Facility Alternative. There would be small annual beneficial impacts to local and state revenues from an increase in personnel income, sales, and property taxes during the construction period of the New Facility Alternative of approximately $9 million.

Less than one additional teacher, firefighter, and police officer would be required to maintain current levels of service. Therefore, there would be a negligible impact to public service levels from the construction period of the New Facility Alternative.

Total employment numbers at NRF would fluctuate during the construction period due to activities unrelated to the proposed action (e.g., performing naval spent nuclear fuel examinations and facility maintenance needs). Since NRF employment unrelated to the proposed action is projected to increase during this period, the total increase in NRF employment during the construction period would be about 420 workers.

Transition Period

Operations of the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. At the peak of the transition period, approximately 60 additional naval spent nuclear fuel handling jobs would be created at NRF providing a small beneficial impact to employment. This would result in 110 additional indirect jobs in the community. The additional 60 jobs at NRF would result in an increase to INL employment of about 0.7 percent, and an increase to NRF employment of approximately 4.4 percent. Assuming 70 percent of the naval spent nuclear fuel handling workforce to be non-local (based on current NRF workforce data) and all indirect labor is local, there would be a negligible impact from an increase of 100 people in the ROI, or approximately 0.03 percent. Impacts to the socioeconomic environment during the transition period for the New Facility Alternative are shown in Table 4.10-4.

Table 4.10-4: Socioeconomic Impacts for the Transition Period of the New Facility Alternative

Parameter	Annual Impacts
Number of Jobs:	
Direct	60
Indirect	110
Total	170
Income[1] ($ millions per year):	
Direct	7.5
Indirect	12.0
Total	19.5
Tax Revenues[1] ($ millions per year):	
State Income Taxes	1.5
Sales and Use Taxes	0.6
Property Taxes	0.2
Total	2.3
New ROI Residents	100
Housing Units Required	40
Public Service (number of new employees):	
Police Officers	<1
Firefighters	<1
Teachers	2

[1]2011 dollars (includes direct and indirect jobs).
Note: Multiplier for jobs is 1.7956; multiplier for income is 1.5951 (BEA 2011).

The population increase during the transition period for the New Facility Alternative would result in a negligible impact from a decrease of approximately 0.5 percent of the available vacant housing; therefore, there would be a negligible impact to the housing vacancies during the transition period for the New Facility Alternative. Additionally, there would be a small beneficial impact from the income and tax revenues created by direct and indirect jobs. Direct income from INL employment would increase by approximately 1.1 percent of the total INL income. There would be small annual beneficial impacts to local and state revenues from an increase in personnel income, sales, and property taxes during the transition period of the New Facility Alternative of approximately $2 million.

To support the increase in population, two additional teachers would be required and less than one additional firefighter or police officer would be needed to maintain current service levels. Therefore, there would be a small impact to public service levels from the transition period of the New Facility Alternative.

Total employment numbers at NRF would fluctuate during the transition period due to activities unrelated to the proposed action (e.g., performing naval spent nuclear fuel examinations and facility maintenance needs). Since NRF employment unrelated to the proposed action is projected to decrease during the transition period, the total increase in NRF employment during this time period would be about 45 workers.

New Facility Operational Period

The New Facility Operational Period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF. During this time period, there would be approximately 60 fewer naval spent nuclear fuel handling jobs at NRF from those presented in Section 3.10 reflecting efficiency gains in the new facility. The loss of 60 naval spent nuclear fuel handling jobs would cause a decrease to INL employment of less than 0.8 percent and a decrease of approximately 4.4 percent to NRF employment. The decrease in the number of naval spent nuclear fuel handling jobs at NRF would be managed through normal attrition, the annual average rate of which exceeds 4.4 percent at NRF. Decrease of 60 naval spent nuclear fuel handling workers would result in the loss of about 110 indirect jobs in the community (Table 4.10-5), resulting in a small impact to employment. Assuming 70 percent of the naval spent nuclear fuel handling workforce is non-local (based on current NRF workforce data) and all indirect labor is local, there would be a loss of 100 people in the ROI population, or about 0.03 percent, resulting in a negligible impact from a decrease in the ROI population. Impacts to the socioeconomic environment during the new facility operational period for the New Facility Alternative are shown in Table 4.10-5.

Table 4.10-5: Socioeconomic Impacts for the New Facility Operational Period

Parameter	Annual Impacts
Number of Jobs:	
Direct	-60
Indirect	-110
Total	-170
Income[1] ($ millions per year):	
Direct	-7.5
Indirect	-12.0
Total	-19.5
Tax Revenues[1] ($ millions per year):	
State Income Taxes	-1.5
Sales and Use Taxes	-0.6
Property Taxes	-0.2
Total	-2.3
New ROI Residents	-100
Housing Units Required	-40
Public Service (number of new employees):	
Police Officers	0
Firefighters	0
Teachers	-2

[1]2011 dollars (includes direct and indirect jobs).
Note: Multiplier for jobs is 1.7956; multiplier for income is 1.5951 (BEA 2011).

There would be a small impact to employment during the new facility operational period. The population decrease in the ROI would vacate approximately 0.5 percent of housing causing a negligible impact to vacancies. Direct income from INL employment would decrease by approximately 1.1 percent of the total INL income. There would be small annual impacts to local and state revenues from a decrease in personnel income, sales, and property taxes during the operational period of the New Facility Alternative of approximately $2 million.

As a result of the decrease in population about two fewer teachers would be required with no changes to the police or firefighters required. Therefore, there would be no impact to public service levels from the operational period of the New Facility Alternative.

Total employment numbers at NRF would fluctuate during the new facility operational period due to activities unrelated to the proposed action (e.g., performing naval spent nuclear fuel examinations and facility maintenance needs). Since NRF employment that is unrelated to the proposed action is projected to decrease during this time period, the total decrease in NRF employment for the operational period would be about 110 workers.

4.11 Energy Consumption, Site Utilities, and Security Infrastructure

This section discusses the potential impacts associated with energy use, utility infrastructure, and security infrastructure for the ROI (INL and NRF) associated with the alternatives. Transportation infrastructure (i.e., roads and rails) is discussed in Section 4.2.

This section evaluates increased demand and infrastructure modifications for the proposed action and compares them to the current maintenance and operation of ECF (Section 3.11) in the following areas:

- Consumption of electricity and fuel (Energy Consumption)
- Changes to water, gas, and electrical systems (Site Utilities)
- Changes to security infrastructure (Security Infrastructure)

Impacts from the consumption of electricity and fuel would occur if demand exceeds the existing capacity. Impacts to utility infrastructure would occur if the existing infrastructure is not sufficient to support the alternatives. Impacts to security would occur if additional security infrastructure is needed.

4.11.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

Current NRF operations consume approximately 10 percent of the current INL contract limit for electricity (Section 3.11) and approximately 0.3 percent of the current Federal Reserved Water Right for INL (Section 3.4.2.4). The No Action Alternative would not result in an increased demand for energy at NRF over the baseline presented in Section 3.11, modifications to site utilities, or security infrastructure changes. Therefore, there would be no impact to energy consumption, site utilities, and security infrastructure from the No Action Alternative.

4.11.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations.

Energy Consumption

During the refurbishment period of the Overhaul Alternative, an incremental and temporary increase in energy demand may be required due to the use of additional equipment and tools. The additional tools and equipment are estimated to increase electricity demand at NRF by approximately 0.5 megawatts. This would be an approximately 10 percent increase at NRF resulting in small impacts to electrical capacity during the refurbishment period of the Overhaul Alternative. There would be an increase of approximately 1 shipment per day of materials and a 4 percent average increase in personnel vehicles during the refurbishment period of the Overhaul Alternative, as provided in Section 4.2.2. These additional vehicles and trucks along with the continued shipments of waste would consume a small amount of diesel fuel and gasoline during the refurbishment period. There would be small impacts to energy consumption during the refurbishment period of the Overhaul Alternative.

Site Utilities

There would be no impact to site utilities because no site utility modifications would be necessary for the refurbishment period of the Overhaul Alternative.

Security Infrastructure

During the refurbishment period of the Overhaul Alternative, a new security boundary system would be built to comply with the security standoff distances applicable to new construction at NRF. The majority of land disturbance for a new security boundary system would occur over a period of about 1 year during the refurbishment period. Although the refurbishment period does not involve new construction, the overhaul actions are considered a significant investment, requiring protection through a new security boundary system with an adequate standoff distance from the facility (DOE 2009). Beneficial impacts to security infrastructure would result from the additional security infrastructure for the refurbishment period of the Overhaul Alternative. Figure 4.11-1 shows the approximate location of a new security boundary system for the Overhaul Alternative.

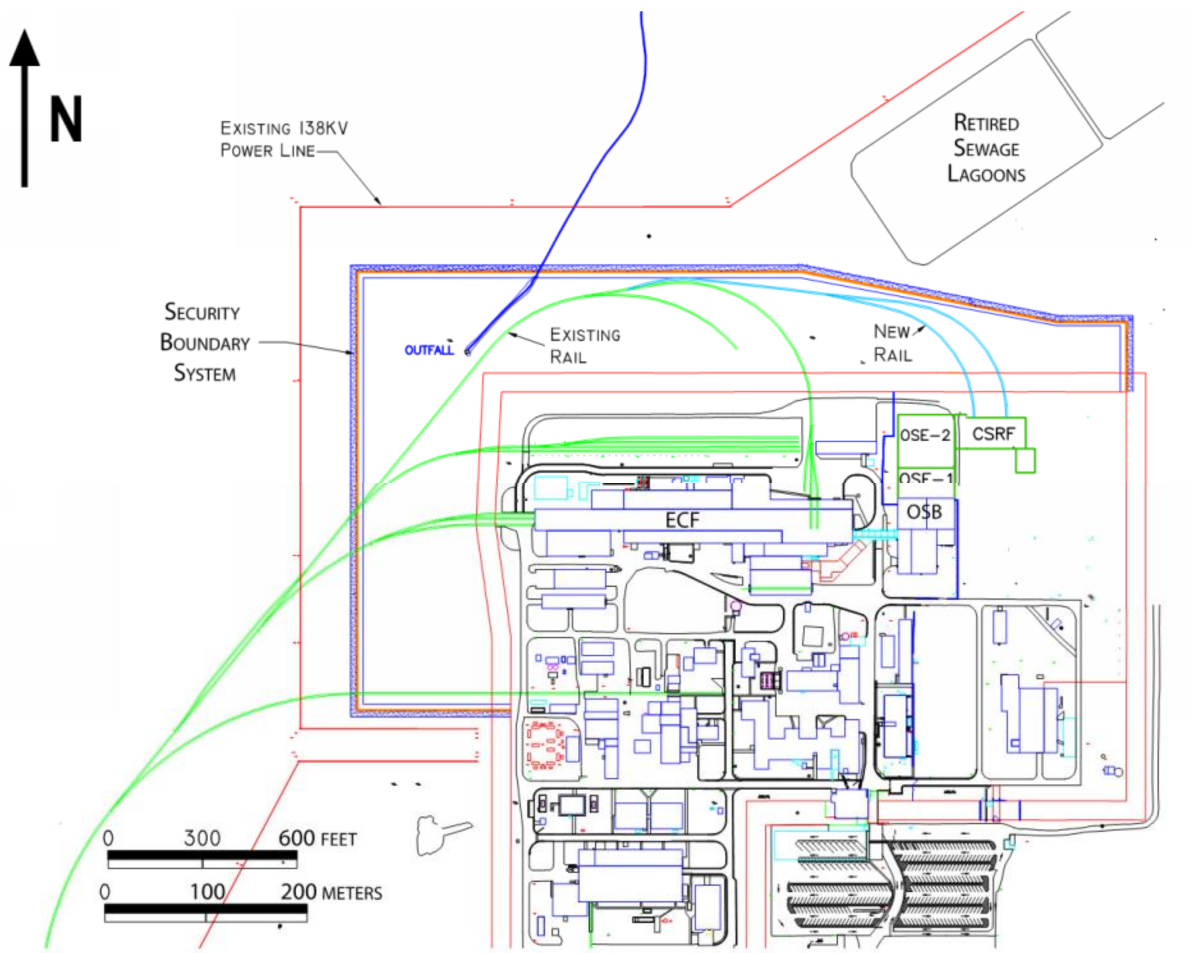


Figure 4.11-1: New Security Boundary System for the Overhaul Alternative

Facility Environmental Sustainability

EO 13693 requires Federal buildings to comply with the Federal High Performance and Sustainable Building Guiding Principles (Guiding Principles) for sustainable new construction and major renovations. The Guiding Principles focus on six categories:

- Employ Integrated Design Principles
- Optimize Energy Performance
- Protect and Conserve Water
- Enhance Indoor Environmental Quality
- Reduce Environmental Impacts of Materials
- Assess and Consider Climate Change Risks

An overhauled ECF would comply with the Guiding Principles because it would be considered a major renovation. Sustainability guidelines would be pursued to the extent that they do not conflict with NNPP requirements.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. There would be beneficial impacts to energy consumption and environmental sustainability due to incorporation the Guiding Principles into the renovation as discussed above. There would be beneficial impacts to security infrastructure during the post-refurbishment period of the Overhaul Alternative from the addition of the new security boundary system. There would be no impact to site utilities during the post-refurbishment operational period of the Overhaul Alternative because no site utility modifications would be necessary.

4.11.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. The impacts to infrastructure from construction activities of the New Facility Alternative are presented in this section in terms of changes to the baseline established in Section 3.11.

Energy Consumption

The estimated energy consumption for the construction period of the New Facility Alternative is approximately the same regardless of where on NRF the new facility would be built. The electrical demand for the construction period of the New Facility Alternative at NRF was estimated from the power needed for various tools and equipment. These demands would not differ between Location 3/4 and Location 6. The peak demand for electricity would occur toward the end of the construction period once the building is constructed, major systems are installed, and the finishing work by craftsmen (e.g., welding, drilling) begins. The peak demand results in an increase of electricity consumption at NRF of 5.1 megawatts, or an increase of 85 percent (at Location 3/4 or Location 6) over the baseline established in Section 3.11. This increase in electricity consumption will result in site utility modifications as described below. Therefore, there would be small impacts from electricity consumption during the construction period of the New Facility Alternative.

During construction of the new facility, diesel fuel consumption would increase based on the delivery of supplies and materials via truck from Idaho Falls and the equipment that would be expected to be used during construction. There would be an increase of approximately 50 shipments of materials per day and a 7 percent average increase in personnel vehicles during the construction period of the New Facility Alternative, as described in Section 4.2.3. These additional vehicles and trucks, along with the continued shipments of waste, would consume a small amount of diesel fuel and gasoline during the construction period. There would be small impacts to diesel fuel consumption during the construction period of the New Facility Alternative. Impacts to air quality from the increase in diesel fuel use are evaluated in Section 4.6.1.5.

During construction of the new facility, the gasoline consumption would increase slightly due to limited use of certain equipment powered by gasoline rather than diesel fuel. This increase would have negligible impact on energy consumption during the construction period of the New Facility Alternative. Impacts to air quality from the increase in gasoline use are evaluated in Section 4.6.1.5.

During the construction period of the New Facility Alternative, fuel oil would not be used for construction activities.

<u>Site Utilities</u>

The existing NRF infrastructure cannot support the electrical demand during the construction period of the New Facility Alternative; therefore, a new substation would be built to support the additional electrical demand. The substation would tie into the INL loop between the existing NRF substation and Test Area North by new overhead transmission lines. Test Area North is shown in Figure 3.11-1. At Location 3/4, the substation would be constructed north of the new facility. At Location 6, the substation would be constructed between the existing NRF substation and the Advanced Test Reactor (ATR) Complex. The land disturbed would be on NRF property and is covered in Section 4.1.3.

During the construction period of the New Facility Alternative, some of the existing utilities (including the potable water lines and a fire water line) within the excavation area would be removed or relocated prior to any excavation. The land that would be disturbed in the excavation area is covered in Section 4.1.3.

During the construction period of the New Facility Alternative, additional potable water piping would be connected to an existing potable water main to support operations during the transition period and the new facility operational period. Prior to any potable water line construction, consultation with and concurrence from the IDEQ would be required and regulations from IDAPA 58.01.08 would be followed. The impacts to the potable water system at NRF would be small because the potable water systems would be altered to increase length of piping.

During the construction period of the New Facility Alternative, additional sanitary sewer piping and a potential new sewage lift station would be installed to support operations during the transition period and the new facility operational period of the New Facility Alternative. Prior to any sewer line or lift station construction, consultation with and concurrence from the IDEQ would be required and regulations from IDAPA 58.01.08 would be followed. The impacts to the sanitary sewer system at NRF would be small because some alterations to the system would be necessary.

At Location 3/4, a local storm water collection system would be used that discharges water by gravity flow into two lined evaporation ponds located on the north and southeast sides of the new facility, as shown in Figure 4.4-1. Runoff from the facility roof, grounds, roads, and sidewalks would be collected by a culvert system and discharged to one of the two storm water evaporation ponds. The lined ponds would contain the storm water on-site and allow it to eventually evaporate.

Location 6 is in close proximity to the existing storm water line that discharges to the IWD. Therefore, a pump and lift station could be installed (if necessary), and the drainage system for Location 6 would tie-in to the existing storm water line. Storm water would be discharged to the IWD where evapotranspiration and local infiltration would occur. As described in Section 3.4, water discharged to the IWD has no potential for reaching the Big Lost River, and the water is managed on the NRF site. Approval from IDEQ on the storm water system would be required, and applicable regulations contained in IDAPA 58.01.16 and IDAPA 58.01.17 would be followed. Therefore, the impacts to the storm water system at NRF would be moderate for construction at either Location 3/4 or Location 6.

During the construction period of the New Facility Alternative, temporary water lines would be needed for the batch plant (Section 4.6.1.5 for batch plant description) and construction trailer area. See Figure 4.1-2 for the proposed batch plant at Location 3/4 and Figure 4.1-3 for the proposed batch plant at Location 6 of the New Facility Alternative. The temporary water supply to the batch plant would be from the NRF fire water system. Impacts to site utilities would be small during the construction period of the New Facility Alternative from the addition of temporary water lines.

The fire water system for the new facility would use existing wells and piping to provide water; however, new tanks, pumps, and piping to store water and make it available during an emergency may be installed to support operations during the transition period and the new facility operational period of the New Facility Alternative. Fire water would be stored in dedicated storage tanks that would be designed and installed in compliance with NFPA 22, *Standard for Water Tanks for Private Fire Protection.* The impacts to the NRF fire water system at either NRF location during the construction period of the New Facility Alternative would be moderate if additional tanks, pumps and piping are installed to support operations during the transition period and the new facility operational period.

A retention basin may be installed for the new facility during construction. The retention basin would be used to hold water pool water during operations in situations where it would be necessary to drain a portion of the water pool for maintenance or installation of new equipment. Impacts to site utilities would be small during the construction period of the New Facility Alternative from the addition of a retention basin.

<u>Security Infrastructure</u>

Security infrastructure would be added during the construction period of the New Facility Alternative. Where necessary, a new personnel fence would be constructed to restrict construction workers access to the operational areas of NRF. A new security boundary system would be constructed to provide adequate standoff from the new facility (DOE 2009). Figures 4.11-2 and 4.11-3 show the approximate location of the security boundary system at Location 3/4 and Location 6, respectively. Beneficial impacts to security infrastructure would result from the additional security infrastructure during the construction period of the New Facility Alternative.

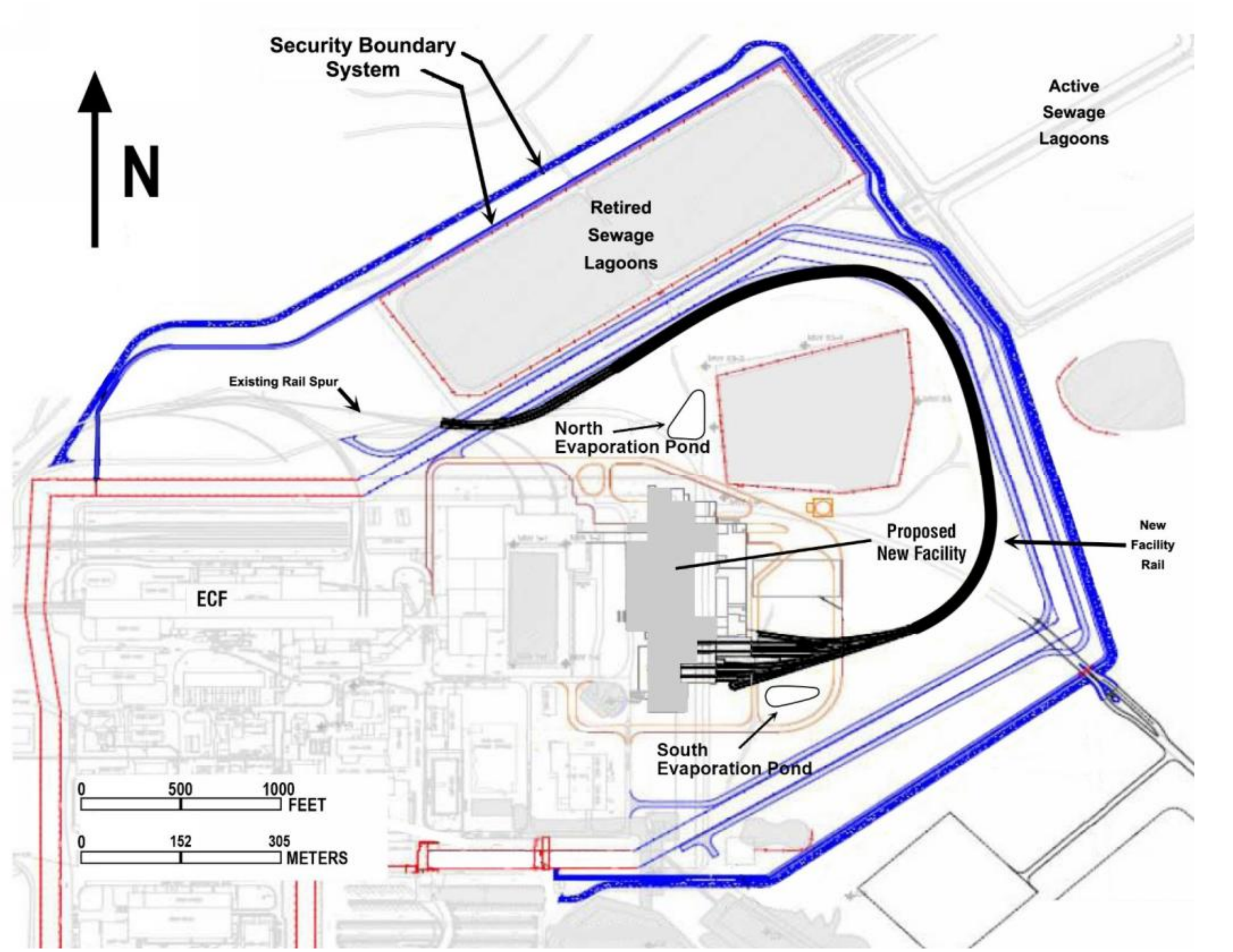


Figure 4.11-2: New Security Boundary System for the New Facility Alternative at Location 3/4

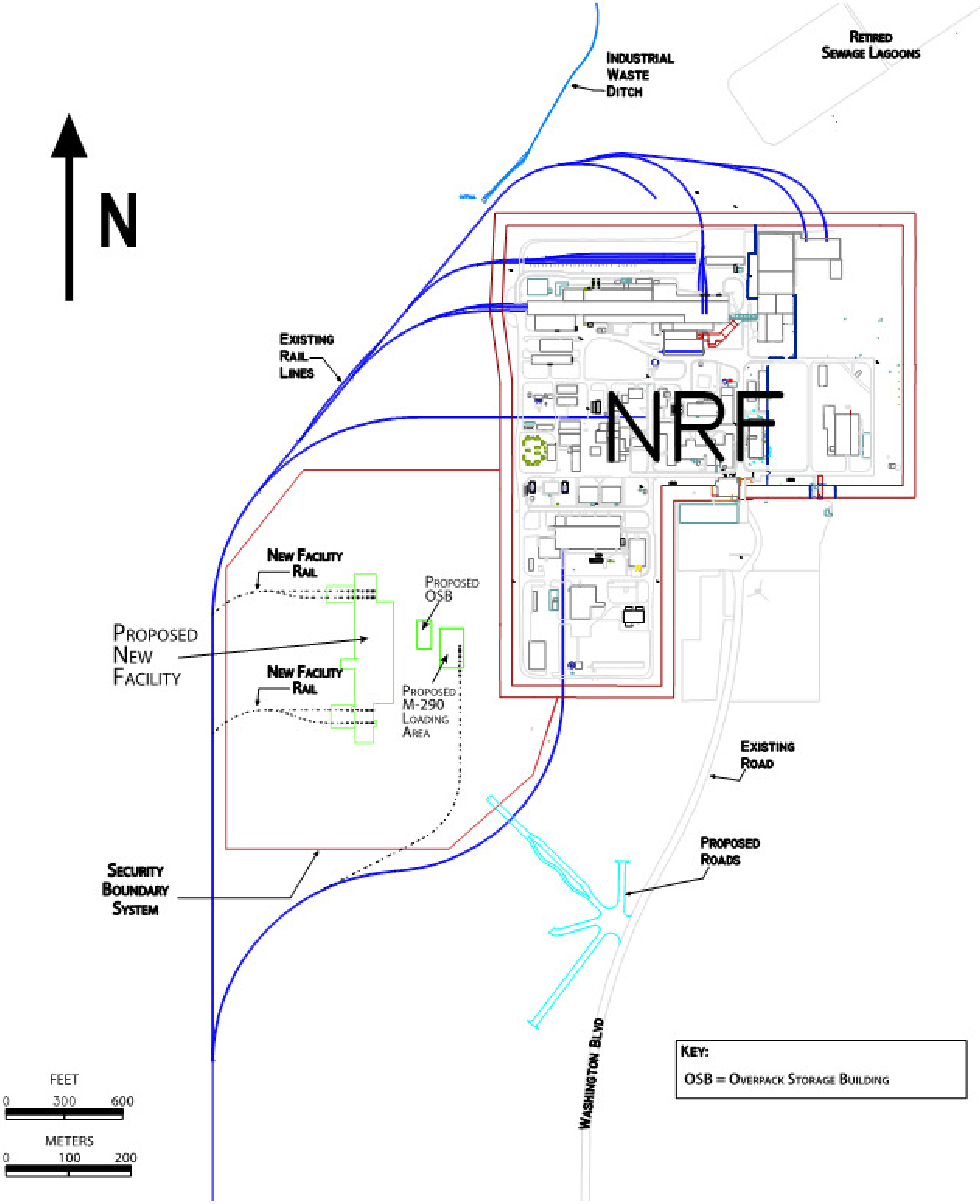


Figure 4.11-3: New Security Boundary System for the New Facility Alternative at Location 6

Facility Environmental Sustainability

The new facility would comply with the Guiding Principles. Sustainability guidelines would be achieved to the extent that they do not conflict with NNPP requirements.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years.

Energy Consumption

During the transition period of the New Facility Alternative, the electrical demand is expected to increase over the baseline by 12 megawatts, which is attributable to the projected electricity demand for operation of the new facility. The bulk of the energy use for the new facility would likely come from heating the facility with electric boilers in the winter, facility ventilation requirements for contamination control, and air conditioning. This projected electrical demand during the transition period of the New Facility Alternative combined with the NRF electrical demand of 6 megawatts would result in a total NRF electrical demand of approximately 18 megawatts, an approximately 200 percent increase in electrical demand described in Section 3.11. The peak load at INL was 30 megawatts in 2011; with the additional load from NRF during this time-frame, the contract demand in the agreement with Idaho Power (45 megawatts) would not be exceeded. In addition, as described in Section 3.11, the maximum contract demand has a ceiling of 55 megawatts; however, DOE has the ability under the agreement with Idaho Power to ask for additional demand above the 55 megawatt ceiling, which may be granted at Idaho Power's discretion. Therefore, the electrical demand during the transition period of the New Facility Alternative would create a moderate impact.

For conservatism in the evaluation of energy consumption, the above electrical demands are based on the use of electric boilers to heat the new facility. To provide a conservative evaluation of air emissions, Section 4.6.1.5 assumes fuel oil would be used to power fuel oil-fired boilers for heating the new facility. Therefore, this section addresses energy consumption from the use of either electric or fuel oil-fired boilers for the new facility.

If fuel oil-fired boilers are used for the new facility, the fuel oil consumption at NRF would increase by approximately 1,151,000 liters (304,000 gallons) or 50 percent from the baseline discussed in Section 3.11. Small impacts to energy consumption are expected during the transition period of the New Facility Alternative from the increase in consumption of fuel oil. Impacts to air quality from fuel oil use are evaluated in Section 4.6.1.5.

The current EDGs at NRF do not have the capacity to provide the projected additional standby power required for the new facility; therefore, a new standby power system would be needed. The use of standby generators during the transition period would consume approximately 62,600 liters (16,540 gallons) of additional diesel fuel resulting in an approximately 150 percent increase from the baseline discussed in Section 3.11.

A diesel fuel storage tank would support the standby generators. This tank would contain approximately 37,850 liters (10,000 gallons) of diesel fuel. Standby (or backup) generators and the fire pump generator would only be used for routine maintenance, testing, and training; therefore, the increase in diesel fuel use would be negligible for these generators. Small impacts are expected during the transition period of the New Facility Alternative from the increase in consumption of diesel fuel. Impacts to air quality from diesel fuel use are evaluated in Section 4.6.1.5.

During the transition period, diesel fuel consumption would not increase based on the delivery of supplies and materials via truck from Idaho Falls. There would be no increase of materials shipments and no increase of waste shipments; however, there would be a 2 percent average increase in personnel vehicles during the transition period of the New Facility Alternative, as provided in Section 4.2.3. These additional vehicles, along with the continued shipments of materials and waste, would consume a small amount of diesel fuel and gasoline. There would be small impacts to energy consumption from diesel fuel use and gasoline use during the transition period of the New Facility Alternative from the additional vehicles of commuting workers.

<u>Site Utilities</u>

During the transition period of the New Facility Alternative there would be no impact to site utilities because no site utility modifications would be necessary.

<u>Security Infrastructure</u>

There would be beneficial impacts to security infrastructure during the transition period of the New Facility Alternative from the addition of the new security boundary system.

<u>Facility Environmental Sustainability</u>

The new facility would comply with the Guiding Principles. Sustainability guidelines would be achieved to the extent that they do not conflict with the NNPP requirements.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only naval spent nuclear fuel and irradiation test specimen examination work continues in ECF.

<u>Energy Consumption</u>

The energy consumption during the new facility operational period would not change from that described for the transition period; therefore, there would be moderate impacts from electrical demands during the operational period of the New Facility Alternative.

During the new facility operational period, diesel fuel consumption would not increase based on the delivery of supplies and materials via truck from Idaho Falls. There would be no increase of materials shipments and no increase of waste shipments; however, there would be a decrease of less than 1 percent of vehicles during the operational period of the New Facility Alternative, as provided in Section 4.2.3. There would be no impacts to energy consumption from diesel fuel use or gasoline use during the operational period of the New Facility Alternative.

<u>Site Utilities</u>

During the operational period of the New Facility Alternative there would be no impact to site utilities because no site utility modifications would be necessary.

<u>Security Infrastructure</u>

There would be beneficial impacts to security infrastructure during the operational period of the New Facility Alternative from the addition of the new security boundary system.

Facility Environmental Sustainability

The new facility would comply with the Guiding Principles. Sustainability guidelines would be achieved to the extent that they do not conflict with NNPP requirements.

4.12 Environmental Justice

This section discusses impacts to environmental justice populations within the 80.5-kilometer (50-mile) radius of NRF (Table 3.12-1). The 80.5-kilometer (50-mile) radius was selected because it is consistent with the ROI for air emissions and because it includes portions of the seven counties that constitute the ROI for socioeconomics.

EO 12898 established the need to identify and address disproportionately high and adverse human health or environmental effects of federal activities on environmental justice populations. Since impacts to environmental justice populations are evaluated for the 80.5-kilometer (50-mile) radius from the alternatives, and all alternatives are at NRF, the format of this section has been altered to present the impacts from all the alternatives as a single discussion. This section discusses environmental monitoring, the results of which show that the impacts to all populations - not just Native American, minority, and low-income populations - are small.

4.12.1 Minority and Low-Income Populations

For this analysis, 2010 U.S. Census data for the number and type of minority populations from the 80.5-kilometer (50-mile) radius (Section 3.12) were compared to the general population of the seven-county ROI. Demographic maps were prepared with the locations and numbers of families above and below the poverty level by projecting population levels and minority populations from the 2010 U.S. Census and by employing the most recent data available. Data for the 80.5-kilometer (50-mile) radius were analyzed at the U.S. Census block group geographic level, which generally contains between 250 and 500 housing units and was the finest resolution available for families below the poverty level. Data for the seven-county ROI were taken from the U.S. Census Bureau data as described in Section 3.12.

Consistent with the definitions of minority and low-income population from CEQ 1997 defined in Section 3.12, the threshold to be met in this analysis for a population to be considered a minority or low-income population is when the minority or low-income population of the affected area exceeds 50 percent, or the minority or low-income population percentage of the affected area is meaningfully greater, such as 20 percent greater, than the minority or low-income population percentage in the seven-county ROI.

Table 4.12-1 shows the minority population within an 80.5-kilometer (50-mile) radius from NRF. The total percent minority population within the NRF 80.5-kilometer (50-mile) radius is approximately 18 percent. This is approximately 7 percent higher than the minority population of the state of Idaho at approximately 11 percent (Table 3.12-2). The total percent minority population within the NRF 80.5-kilometer (50-mile) radius is also approximately 7 percent higher than the minority population of the ROI (Table 3.12-2). Figure 3.12-1 indicates that environmental justice populations would occur where the census block groups show a high density of minority population per square mile. These census block groups are located about 64 kilometers (40 miles) and 80 kilometers (50 miles) to the south and east of NRF and are close to or within the population centers of Blackfoot, Ammon, Idaho Falls, Rigby, and a small area north of the American Falls reservoir.

Table 4.12-1: Minority Population Within the 80.5-Kilometer (50-Mile) Radius of NRF

Environmental Justice Population	Population	Percent Minority
Native American	3945	2.5
Hispanic	21,477	13.5
African American	712	0.4
Asian	1147	0.7
Other	1513	1.0
Total Minority	28,794	18.1
Note: Total population of ROI is approximately 159,000.		

An estimated 17,862 individuals, or approximately 11 percent of individuals within an 80.5-kilometer (50-mile) radius from NRF, are below the poverty level (Table 3.12-1). This percentage falls below the seven-county ROI estimated average of 15 percent and the state of Idaho estimated average of 14 percent of individuals below the poverty level (USCB 2012c). Figure 3.12-2 indicates that environmental justice populations would occur where the census block groups show a high density of low-income population per square mile. These census block groups are located about 64 kilometers (40 miles) and 80 kilometers (50 miles) to the south and east of NRF and are close to or within the population centers of Blackfoot, Ammon, Idaho Falls, Rigby, and a small area north of the American Falls reservoir.

4.12.2 Disproportionately High and Adverse Human Health or Environmental Effects

CEQ 1997 defines disproportionately high and adverse human health or environmental effects as:

- Health or environmental effects that may be measured in risks and rates that are significant or above generally accepted norms
- Risk or rate of hazard exposure by a minority, low-income population, or Native American tribe to an environmental hazard is significant and appreciably exceeds, or is likely to appreciably exceed, the risk or rate to the general population or other appropriate comparison group
- Health or environmental effects occur in a minority population, low-income population, or Native American tribe affected by cumulative or multiple adverse exposures from environmental hazards
- Impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native Americans

To have disproportionately high and adverse human health or environmental effects on minority and low-income populations, minority or low-income populations would need to be concentrated (as described above) in geographic areas with high risk of exposure to radiation, hazardous chemicals, or potential accidents. Areas considered include geographic areas downwind from air emissions, or areas in close proximity to pollution sources. Additionally, high risk or exposure could occur through subsistence consumption of contaminated vegetation, fish, or wildlife. Impacts to Native American populations could occur from interrelated impacts (e.g., ecological, cultural, and traditional use areas) to the natural or physical environment. Impacts to the Shoshone-Bannock Tribes on the Fort Hall Reservation, and their use on the INL of sacred and traditional-use areas, natural landscapes, water, and ecological resources that are of special significance to them are evaluated (Section 4.8).
In accordance with DOE Orders, environmental sampling is performed at several locations on the INL, at the INL boundary, and at various distances from the INL. Environmental samples taken at various distances from the INL boundary include locations at Blackfoot and on the Fort Hall Indian Reservation to monitor for possible impacts to the Shoshone-Bannock Tribes. Potential pathways for

contaminants to reach humans are sampled and monitored. These pathways include air, water, precipitation, soil, agricultural products, and fish and wildlife as it relates to ingestion. (ESER 2011)

To address possible impacts from consumption, including subsistence consumption, DOE routinely samples game species residing on INL. Large game animals (pronghorn, mule deer, and elk) are sampled whenever they are killed from vehicle collisions on-site or at the INL boundary. Waterfowl are collected in either the third or fourth quarter and sampled. Data from programs monitoring game sources of food and other sources such as livestock, agricultural products such as milk, potatoes, wheat, and lettuce are reported and published annually. Monitoring locations for agricultural products include traditional use areas of the Shoshone-Bannock Tribes and are located near Blackfoot and Fort Hall. (ESER 2011)

None of the radionuclides detected in samples collected on the INL, the traditional use areas of the Shoshone-Bannock Tribes, and the areas surrounding the INL during 2010 could be directly linked with INL activities. Levels of detected radionuclides were the same as values measured at other locations across the U.S. or were consistent with levels measured historically at the INL. All detected radionuclide concentrations are well below guidelines set by the DOE and regulatory standards established by EPA for protection of the public (ESER 2011). As described in Section 4.6.2, radiological emissions from NRF are expected to remain at 0.03 percent of INL emissions.

For all alternatives, there would be no disproportionately high and adverse impacts to minority or low-income populations.

4.13 Public and Occupational Health and Safety Impacts

This section analyzes the potential non-radiological and radiological impacts on public and occupational health and safety from the proposed action. The ROI for occupational health and safety is NRF, the location of the proposed action. The ROI for general health effects from radiation exposure and emissions is the 80.5-kilometer (50-mile) radius from NRF.

Non-Radiological Impacts

DOE has the authority to establish and enforce occupational health and safety standards as addressed in Section 3.13. NNPP facilities track numerous occupational health and occupational medicine performance indicators that are consistent with those of general industry using OSHA occupational injury and illness reporting criteria (NNPP 2011c). The performance indicators are used to describe several of the potential impacts to occupational health and safety in Section 4.13.1.

Radiological Impacts

In over 6600 reactor-years of operation of naval reactors and more than 829 shipments of naval spent nuclear fuel, there has never been a nuclear reactor accident, criticality accident, or any release of radioactivity having a significant effect on the quality of the environment (NNPP 2014). However, the consequences of radiation exposure and contamination are of interest to the general public; therefore, Section 4.13.2 also addresses the potential radiological impacts to the public and occupational health and safety from routine naval spent nuclear fuel handling operations and hypothetical accidents for the proposed action.

Appendix F provides the evaluation of potential impacts from a release of radioactive materials from routine naval spent nuclear fuel handling operations, hypothetical accidents, and intentionally destructive acts (IDAs) (e.g., acts of sabotage or terrorism). The results of the radiological analyses are presented in terms of both consequence (fatal cancer that might be expected for an individual or population group) and risk (the increased chance of developing fatal cancer).

4.13.1 Non-Radiological Health and Safety Impacts

No non-radiological health and safety impacts are expected to the public because construction, refurbishment, and operations activities would take place at NRF on INL approximately 10.5 kilometers (6.5 miles) from the INL property boundary. Therefore, only occupational non-radiological health and safety impacts are evaluated.

Performance indicators are used to describe several of the potential impacts to occupational health and safety in Section 4.13.1. A Days Away, Restricted or on-the-Job Transfer (DART) case is described as an injury or illness case where the most serious outcome of the case resulted in days away from work or days of job restriction or transfer. Total Recordable Cases (TRC) are defined as the total number of work related injuries or illnesses that resulted in death, days away from work, job transfer or restriction, or other recordable case.

OSHA specifies the recording of all work-related injuries or illnesses that need treatment beyond first aid. For example, a cut requiring stitches and a disabling back injury are each counted as an injury and are not distinguishable from each other in the reporting system. The severity of a recordable injury or illness is indicated by the restriction of the employee’s work activity and/or days away from work. Injuries and illnesses reported at NRF are generally minor, such as cuts and abrasions, and require little or no lost time from work. (NNPP 2011c)

4.13.1.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While operations in ECF continue, there would be no change to the number of workers as described in Section 4.10; therefore, there would be no increases in the number of injuries, illnesses, and fatalities for naval spent nuclear fuel handling workers from the baseline conditions described in Section 3.13.

If operations in ECF cease, there would be a decrease in the number of workers as described in Section 4.10; therefore, there would be a decrease in the number of injuries, illnesses, and fatalities for naval spent nuclear fuel handling workers from the baseline conditions described in Section 3.13.

Therefore, there would be no non-radiological impact from the No Action Alternative.

4.13.1.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. Naval spent nuclear fuel handing operations and refurbishment activities during the refurbishment period would meet applicable OSHA, state of Idaho, NNPP, and local NRF occupational and industrial safety requirements.

Similar to baseline conditions, naval spent nuclear fuel handling operations workers in ECF during the refurbishment period could have the potential for accidents related to material-handling, trips, lacerations, musculoskeletal injuries, slips, and subsequent falls. Resultant injuries could include minor temporary injuries, long-term injuries (or disabilities), and fatalities. These impacts would be minimized using NNPP work control practices and proper personal protective equipment. Naval spent nuclear fuel handling operations workers would follow the current hearing protection requirements discussed in Section 3.7.

During the refurbishment period, refurbishment activities within ECF and from the construction of the new security boundary system could impact the refurbishment workforce, an average of 180 refurbishment workers, in addition to the naval spent nuclear fuel handling workers in ECF (Section 4.10). Potential hazards typical of a refurbishment and construction environment would include: construction vehicle accidents, material handling accidents, pedestrian-vehicle accidents, falls from elevated surfaces, lacerations, musculoskeletal injuries, and slips, trips, and subsequent falls. Modifications to electrical equipment would pose an increased risk of shock. Activities such as overhauling the water pools, could impact both refurbishment and naval spent nuclear fuel handling workers. Overhauling the water pools would require specialized equipment such as concrete saws and chisels that would expose workers to silica-containing dust as well as increased noise levels. In addition to the refurbishment activities, there would be temporary noise level increases from the construction of the new security boundary system. Resultant injuries could include minor temporary injuries, long-term injuries (or disabilities), and fatalities.

Occupational health hazards during the refurbishment period could also result from exposure of both naval spent nuclear fuel handling operations workers and refurbishment workers to pollutants emitted from diesel-powered and gasoline-powered equipment (e.g., CO, NOx, SOx, and PM), and exposure to vapors from fuels, paints, or solvents. Also, workers could be exposed to asbestos and other contaminated materials. Limited quantities of chemicals classified as hazardous would be handled during the refurbishment period of the Overhaul Alternative.

Workplace hazards from refurbishment activities would be minimized using NNPP work control practices and proper personal protective equipment. Hearing protection is required when noise levels reach and exceed 85 dBA. Refurbishment workers would follow the current hearing protection requirements discussed in Section 3.7. Access to the active refurbishment area would be limited to the authorized and adequately protected workforce. Administrative controls and personnel training ensure compliance with industry standards; and observations of these protocols would prevent exposure of the workers to noise, pollutants, and hazardous chemicals.

Refurbishment workers could also be exposed to radiation from routine naval spent nuclear fuel handling operations occurring in ECF in parallel with the refurbishment activities. These impacts are discussed in Section 4.13.2.

TRC and DART cases are estimated to increase proportionately to the increase in 180 refurbishment workers necessary during the refurbishment period. The increase in numbers of injuries, illnesses, and fatalities from the additional refurbishment workers during the refurbishment period of the Overhaul Alternative are estimated (Table 4.13-1) using annual injury and illness data.

Table 4.13-1: Annual Industrial Safety Impacts for the Refurbishment Period of the Overhaul Alternative

Average Number of Refurbishment Workers	180
TRC Rate per 100 Workers	1.0
Projected Impact to TRC from Refurbishment Workforce	1.8
DART Rate per 100 Workers	0.5
Projected Impact to DART from Refurbishment Workforce	0.9
Fatality Rate per 100,000 Workers	0
Projected Fatalities	0
Source for rates: CAIRS 2013	

Approximately two additional TRCs and less than one additional DART case would be expected annually from this alternative for refurbishment workers. No fatalities to refurbishment workers are expected from the refurbishment period of the Overhaul Alternative. Therefore, occupational health and safety impacts during the refurbishment period of the Overhaul Alternative would be small.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only naval spent nuclear fuel handling activities would take place in ECF. Operations during the post-refurbishment operational period would meet applicable OSHA, state of Idaho, NNPP, and local NRF occupational and industrial safety requirements.

Similar to baseline conditions, naval spent nuclear fuel handling operations in ECF during the post-refurbishment operational period could have the potential for accidents related to material-handling, trips, lacerations, musculoskeletal injuries, slips, and subsequent falls. Resultant injuries could include minor temporary injuries, long-term injuries (disabilities), and fatalities. These impacts would be minimized using NNPP work control practices and proper personal protective equipment. Noise levels would not change from the current noise levels at NRF described in

Section 3.7. Workers would follow the current hearing protection requirements discussed in Section 3.7.

Projected TRC and DART cases are estimated to increase proportionately to the increase of 80 naval spent nuclear fuel handling workers (Section 4.10) during the post-refurbishment operational period of the Overhaul Alternative (Table 4.13-2).

Table 4.13-2: Annual Industrial Safety Impacts for Post-Refurbishment Operational Period of the Overhaul Alternative

Increase in Naval Spent Nuclear Fuel Handling Workers	80
TRC Rate per 100 Workers	1.0
Projected Impact to TRC per Year from Increase in Workers	0.8
DART Rate per 100 Workers	0.5
Projected Impact to DART from Increase in Workers	0.4
Fatality Rate per 100,000 Workers	0
Projected Fatalities at NRF	0
Source for rates: CAIRS 2013	

Less than one additional TRC and less than one additional DART case would be expected annually from the post-refurbishment operational period for naval spent nuclear fuel handling workers. No fatalities to the naval spent nuclear fuel handling workers are expected. Therefore, occupational health and safety impacts during the post-refurbishment operational period of the Overhaul Alternative would be small.

4.13.1.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. ECF operations and new facility construction activities during the construction period would meet applicable OSHA, state of Idaho, NNPP, and local NRF occupational and industrial safety requirements.

Similar to baseline conditions, naval spent nuclear fuel handling operations workers in ECF during the construction period could have the potential for accidents related to material-handling, trips, lacerations, musculoskeletal injuries, slips, and subsequent falls. Resultant injuries could include minor temporary injuries, long-term injuries (disabilities), and fatalities. These impacts would be minimized using NNPP work control practices and proper personal protective equipment. Naval spent nuclear fuel handling operations workers would follow the current hearing protection requirements discussed in Section 3.7.

During this period, workplace hazards from construction activities could impact the construction workforce, an average of 360 construction workers (Section 4.10). Potential hazards typical of a construction environment would include construction vehicle accidents, material handling accidents, structural collapse, pedestrian-vehicle accidents, falls from elevated surfaces, lacerations, musculoskeletal injuries, and slips, trips, and subsequent falls. Noise levels from the operation of heavy equipment, to include bulldozers, compactors, and dump trucks would range from an estimated 80 to 84 dBA measured at 15 meters (50 feet) from the activity. The majority of construction vehicles and equipment would operate within the area of disturbance (Figures 4.1-2 and 4.1-3). Resultant injuries could include minor temporary injuries, long-term injuries (or disabilities), and fatalities.

Occupational health hazards during construction could result from exposure of workers to silica dust due to airborne soil dispersion and to asbestos in existing piping that may be present when workers would connect the existing systems into the new facility systems. Additional occupational health hazards during construction could result from exposure of workers to pollutants emitted from diesel-powered and gasoline-powered equipment (e.g., CO, NOx, SOx, and PM), and exposure to vapors from fuels, paints, or solvents. Limited quantities of chemicals classified as hazardous would be handled during the construction period for the New Facility Alternative.

Work place hazards from construction activities would be minimized using OSHA and NNPP work control practices and proper personal protective equipment. Access to the construction area would be limited to the authorized and adequately protected workforce. Hearing protection would be required for noise levels exceeding 85 dBA. Construction workers would follow the current hearing protection requirements discussed in Section 3.7. Administrative controls and personnel training ensure compliance with industry standards, and observations of these protocols would prevent exposure of the workers to noise, pollutants, and hazardous chemicals.

Numbers of injuries and illnesses potentially incurred by workers during construction were estimated (Table 4.13-3) using annual injury and illness data. TRCs and DART cases are estimated to increase proportionately to the increase in 360 construction workers necessary during the construction period.

Table 4.13-3: Projection of Annual Industrial Safety Impacts for the Construction Period of the New Facility Alternative

Increase in Construction Workers	360
TRC Rate per 100 Workers	1.0
Projected Impact to TRC from Construction Workers	3.6
DART Rate per 100 Workers	0.5
Projected Impact to DART from Construction Workers	1.8
Fatality Rate per 100,000 Workers	0
Projected Fatalities at NRF	0
Source for rates: CAIRS 2013	

Less than four additional TRCs and less than two additional DART cases would be expected annually during the construction period. No fatalities to the construction workers are expected during the construction period of the New Facility Alternative. Therefore, occupational health and safety impacts during the construction period of the New Facility Alternative would be small.

Transition Period

Operations for the New Facility Alterative would overlap with ECF operations for a period of 5 to 12 years. A new facility would meet applicable OSHA, state of Idaho, NNPP, and local NRF occupational and industrial safety regulations and standards.

Similar to baseline conditions, naval spent nuclear fuel handling operations in ECF and the new facility during the transition period could have the potential for accidents related to material-handling, trips, lacerations, musculoskeletal injuries, slips, and subsequent falls. Noise levels would be similar to those from current operations at NRF. Expected noise would not exceed current recorded levels at NRF as described in Section 3.7. Resultant injuries could include minor temporary injuries, long-term injuries (disabilities), and fatalities. These impacts would be minimized using NNPP work control practices and proper personal protective equipment. Naval spent nuclear fuel handling workers would follow the current hearing protection requirements discussed in Section 3.7.

The potential workplace hazards during the transition period would not change from the current conditions in ECF. However, during the transition period, naval spent nuclear fuel handling operations in the new facility would overlap with naval spent nuclear fuel handling operations in ECF, resulting in an increase of approximately 60 naval spent nuclear fuel handling workers at NRF. TRC and DART cases during the transition period of the New Facility Alternative are estimated to increase proportionally to the increase in the number of naval spent nuclear fuel handling workers (Section 4.10). The number of injuries, illnesses, and fatalities potentially incurred by workers during naval spent nuclear fuel handling operations are estimated (Table 4.13-4) using annual injury and illness data.

Table 4.13-4: Projection of Annual Industrial Safety Impacts for the Transition Period of the New Facility Alternative

Increase in Naval Spent Nuclear Fuel Handling Workers	60
TRC Rate per 100 Workers	1.0
Projected Impact to TRC from Increase in Workers	0.6
DART Rate per 100 Workers	0.5
Projected Impact to DART from Increase in Workers	0.3
Fatality Rate per 100,000 Workers	0
Projected Fatalities at NRF	0
Source for rates: CAIRS 2013	

Less than one additional TRC and less than one additional DART case would be expected annually for naval spent nuclear fuel handling workers during the transition period. No fatalities to the naval spent nuclear fuel handling workers are expected. Therefore, occupational health and safety impacts during the transition period of the New Facility Alternative would be small.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF. A new facility would meet applicable OSHA, state of Idaho, NNPP, and local NRF occupational and industrial safety regulations and standards.

Similar to baseline conditions, naval spent nuclear fuel handling operations in the new facility would involve the potential for accidents related to material-handling, trips, lacerations, musculoskeletal injuries, slips, and subsequent falls. Noise levels would be similar to those from current operations at NRF. Expected noise levels for the transition period would not exceed current recorded levels at NRF described in Section 3.7. Resultant injuries could include minor temporary injuries, long-term injuries (disabilities), and fatalities. These impacts would be minimized using NNPP work control practices and proper personal protective equipment. Workers would follow the current hearing protection requirements discussed in Section 3.7.

The potential work place hazards during the new facility operational period would not change from the current conditions in ECF. However, during the new facility operational period, there would be a decrease of 60 naval spent nuclear fuel handling workers at NRF. TRC and DART cases during the new facility operational period are estimated to decrease proportionally to the decrease in the number of naval spent nuclear fuel handling workers (Section 4.10). The number of injuries, illnesses, and fatalities potentially incurred by workers during naval spent nuclear fuel handling operations are estimated (Table 4.13-5) using annual injury and illness data.

Table 4.13-5: Projection of Annual Industrial Safety Impacts for the Operational Period of the New Facility Alternative

Decrease in Naval Spent Nuclear Fuel Handling Workers	60
TRC Rate per 100 Workers	1.0
Projected Decrease to TRC	0.6
DART Rate per 100 Workers	0.5
Projected Decrease to DART	0.3
Fatality Rate per 100,000 Workers	0
Projected Fatalities	0
Source for rates: CAIRS 2013	

During the new facility operational period, there would be a decrease in the number of TRCs and DART cases annually for naval spent nuclear fuel handling workers. No fatalities are expected during the new facility operational period. Therefore, there would be no occupational health and safety impact during the operational period for the New Facility Alternative.

4.13.2 Radiological Health and Safety Impacts

The radiological impacts to occupational and public safety from the proposed action are presented in this section. Radiation exposures to naval spent nuclear fuel handling workers located in a facility (i.e., ECF or the new facility) and to individuals located external to the facility are discussed separately. Health effects are calculated based on the radiation exposure and dose to an individual or population group. Health effects from radiation exposure are used to summarize and compare results in this EIS. Fatal cancer is reported because cancer is the principal health effect which may result from radiation exposure. Appendix F, Section F.2.5 provides a more detailed discussion of the evaluation of health effects from radiation exposure.

The primary sources of radiological impacts from routine naval spent nuclear fuel handling operations are radiological air emissions and direct exposure of individuals to radiation. Radiological impacts can also result from waterborne exposure to radionuclides. Analysis for annual radiological air emissions are based on actual annual releases for ECF in 2009 scaled to future production rates (based on naval spent nuclear fuel canister loading capacity and shipping container unloading capacity as discussed in Section 4.6.2 and Appendix F, Section F.4.1). The waterborne radiation exposure is calculated by assuming airborne emissions are deposited onto the surface water or the ground surface. Those particulates modeled to deposit on the ground surface are assumed to travel to the aquifer. Direct radiation exposure can occur during routine naval spent nuclear fuel handling operations such as unloading shipping containers, loading naval spent nuclear fuel canisters, and repair and maintenance work. These radiation exposures are minimized by good planning, adequate redundancy of key components, designing equipment considering necessary repair and maintenance, controlling contamination at the source, using local shielding, and using equipment decontamination procedures.

4.13.2.1 Radiation Exposures From Routine Naval Spent Nuclear Fuel Handling Operations

Radiation Exposures to Workers in ECF or a New Facility

No one in the NNPP has exceeded 0.02 Sievert (2 rem) of radiation exposure in 1 year (less than half the annual limit of 5 rem) since 1979. In 1979, the Nuclear Regulatory Commission (NRC) issued a proposed change to 10 C.F.R. § 20 to require its licensees to use 5 rem as an annual occupation exposure limit. The DOE annual occupational exposure limit is 5 rem per year (10 C.F.R. § 835). The average radiation exposure per person monitored since 1979 for prototype and NRF personnel is approximately 0.0006 Sievert (0.06 rem) per year. (NNPP 2011b)

For perspective, this average annual radiation exposure of 0.0006 Sievert (0.06 rem) is approximately 1 percent of the 5-rem federal annual limit, less than one-fourth the average annual radiation exposure received by commercial nuclear power plant personnel over the same time period, and less than one-fourth the average annual radiation exposure received by U.S. commercial airline flight crew personnel due to cosmic radiation. Additionally, the average annual radiation exposure since 1979 is one-sixth the average annual radiation exposure to a member of the public in the U.S. from natural background radiation and less than one-fourth the average annual radiation exposure to a member of the public from common diagnostic medical x-ray procedures. (NNPP 2011b)

To keep radiation exposure ALARA, worker radiation exposures at NRF are controlled at levels much lower than the 5-rem annual limit (e.g., typically 0.0010 Sievert (0.10 rem)). Engineering controls such as time in the radiation area, distance away from the source, and shielding are used in conjunction with these control levels to keep radiation exposures ALARA.

Radiation Exposures to Individuals Outside ECF or a New Facility

The radiological impacts of routine naval spent nuclear fuel handling operations from radiation exposures to individuals located outside of ECF or a new facility are evaluated. For these evaluations, impacts to several individuals and the General Population are calculated based on expected activities and behaviors of the individual or group during routine naval spent nuclear fuel handling operations. The comprehensive INL radiation monitoring program shows that radiation exposure to persons who do not work at INL resulting from NRF operations is too small to be measured. However, radiation exposure to the following individuals and the General Population are calculated for the proposed action.

1) Worker - The Worker is an adult individual located 100 meters (330 feet) from the radioactive material release point. The Worker is an NRF employee walking by or working near the naval spent nuclear fuel handling facility that is not directly involved in routine naval spent nuclear fuel handling operations (i.e., an uninvolved worker).

2) Maximally Exposed Co-Located Worker (MCW) - The MCW is an adult worker at another independent INL facility (separate from NRF). The MCW used for this analysis is located 8 kilometers (5 miles) away from NRF at the ATR Complex.

3) Maximally Exposed Off-Site Individual (MOI) - The MOI is an adult member of the public who could potentially be living at the nearest INL property boundary. For routine naval spent nuclear fuel handling operations, the MOI is treated as a full-time resident, and receives the maximum possible radiation exposure to the general public. The MOI is located 10.5 kilometers (6.5 miles) away from NRF in the west-northwest (WNW) direction.

4) General Population - The General Population is the public that resides at various distances beyond the INL boundary. The General Population downwind dose radiation exposure for routine naval spent nuclear fuel handling operations is evaluated in 16-kilometer (10-mile) radial increments from NRF, out to a radius of 80.5 kilometers (50 miles) in each of the 16 compass sectors (e.g., north (N), north-northeast (NNE), northeast (NE)) to account for the population distribution (age and locations). The population distribution is shown in Figure 3.10-2; age distribution is addressed in Appendix F, Section F.3.

The radiation exposure calculations include the radioactive particles or gases released into the atmosphere or into the aquifer from routine naval spent nuclear fuel handling operations via three pathways: airborne, waterborne, and direct radiation. Appendix F describes how the Generalized Environmental Radiation Dosimetry Software System – Hanford Dosimetry System (GENII) Version 2 modeling software is used for the analysis. Airborne contributions to dose are determined using an air dispersion modeling code (GENII) to calculate the doses attributable to air immersion, inhalation, ingestion, and ground shine (radiation from radionuclides deposited on the ground). Waterborne contributions to dose are determined using the GENII modeling software to calculate the doses attributable to water immersion and ingestion (of both water and contaminated foods). Direct radiation contributions for normal operations are determined from a facility design requirement for radiation levels outside a radiological facility attenuated by distance. Details about the analysis methods and assumptions for these radiation exposure calculations are provided in Appendix F, Section F.3.

4.13.2.1.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

Radiation Exposure to Workers in ECF

While operations in ECF continue, there would be no increases in radiation exposure for naval spent nuclear fuel handling workers from the baseline conditions described in Section 3.13.

If operations in ECF cease, there would be no naval spent nuclear fuel handling workers and therefore no radiation exposure to those workers.

Therefore, there would be no radiological occupational health impact from radiation exposure for the No Action Alternative.

Radiation Exposure to Individuals Outside ECF

While operations in ECF continue, the pace of operations could be reduced based on the need to sustain the proper functioning of ECF infrastructure and equipment (Section 4.6.2.1). Although a decrease in emissions cannot be quantified, a subsequent reduction in radiation exposure impacts to individuals outside ECF from those described in Section 3.13.2 could occur.

If operations in ECF cease, a decrease in emissions would occur. A reduction in radiation exposure impacts to individuals outside ECF from those described in Section 3.13.2 would occur.

Therefore, there would be no public health impact from radiation exposure for the No Action Alternative.

4.13.2.1.2 Overhaul Alternative

Refurbishment Period

During the 33-year refurbishment period of the Overhaul Alternative, naval spent nuclear fuel handling and examination operations would continue in ECF concurrent with refurbishment activities.

Radiation Exposures to Workers in ECF

During this period, refurbishment activities and naval spent nuclear fuel handling operations would have the potential to impact an annual average of 180 additional refurbishment workers (Section 4.10). Refurbishment workers could be exposed to radiation through refurbishment activities when handling radioactive materials. However, best management practices and controls described in Section 3.6.6 would minimize the spread of contamination to keep radiation exposures ALARA. Refurbishment workers would have their exposure to naval spent nuclear fuel handling operations limited to only that which is necessary to complete refurbishment activities. Radiation exposure of refurbishment workers from naval spent nuclear fuel handling operations would be limited by establishing boundaries between refurbishment and operation areas.

It is estimated that dose to refurbishment workers during the refurbishment period could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.0006 Sievert (0.06 rem). Collective dose, the dose to the individual multiplied by the number of individuals, can be used to compare impacts to groups of people from alternatives. For the refurbishment period of the Overhaul Alternative, the collective increase in radiological exposure to the refurbishment workers would be 0.11 person-Sievert (11 person-rem) using an average of 0.0006 Sievert (0.06 rem).

The impact of radiation exposure to the occupational health and safety of the refurbishment workers in ECF during the refurbishment period of the Overhaul Alternative would be small. Due to the establishment of boundaries between refurbishment and operation areas, the impacts to radiological health and safety for naval spent nuclear fuel handling workers from the baseline conditions described in Section 3.13 would not increase; therefore, there would be no radiological occupational health impact to naval spent nuclear fuel handling workers from radiation exposure for the refurbishment period of the Overhaul Alternative.

Radiation Exposures to Individuals Outside ECF

The pace of naval spent nuclear fuel handling operations would be reduced due to refurbishment. This reduced pace would result in a reduction of airborne emissions and associated radiation exposure to individuals outside ECF from routine naval spent nuclear fuel handling operations. However, the refurbishment activities would involve handling radiological materials as described in Section 4.6.2. These refurbishment activities could increase the airborne radiological emissions and associated radiation exposure to individuals outside ECF. However, based on best management practices and controls described in Section 3.6.6 to minimize the spread of contamination and keep radiation exposures ALARA, the refurbishment activities would result in a small increase in airborne emissions and radiation exposure. Overall the radiation exposure from the refurbishment period would be similar to the radiation exposure from ECF shown in Table 3.13-5 and Table 3.13-6. Therefore, there would be no radiological health impact to individuals outside ECF during the refurbishment period of the Overhaul Alternative.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. Impacts during the post-refurbishment operational period could occur from routine naval spent nuclear fuel handling and examination operations.

Radiation Exposures to Workers in ECF

There would be 80 additional naval spent nuclear fuel handling workers in ECF during the post-refurbishment operational period (Section 4.10). According to 2010 radiation exposure data for individuals involved in naval spent nuclear fuel handling operations, the highest average annual radiation exposure of 0.00018 Sievert (0.018 rem) was obtained by technicians who unload shipping containers. Therefore, it is estimated that the radiation exposure to a naval spent nuclear fuel handling worker could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.00018 Sievert (0.018 rem). (NNPP 2011b)

The collective increase in dose would be 0.014 person-Sievert (1.4 person-rem), using an average dose of 0.00018 Sievert (0.018 rem). There would be no impact from radiation exposure to an individual naval spent nuclear fuel handling worker in ECF during the post-refurbishment operational period because the individual radiation exposure would not change from the baseline provided in Section 3.13. However, the collective impact from radiation exposure to naval spent nuclear fuel handling workers would be small during the post-refurbishment operational period because of the increase in naval spent nuclear fuel handling workers at ECF.

Radiation Exposures to Individuals Outside ECF

During the post-refurbishment operational period of the Overhaul Alternative, ECF would operate at maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers and loading naval spent fuel canisters to meet the needs of the naval nuclear fleet and the terms of SA 1995 and SAA 2008. The radiological exposure to individuals outside ECF from performing naval spent fuel handling operations at maximum capacity is described below.

Table 4.13-6 presents the radiation exposure and health effects (fatal cancer) to individuals outside ECF from routine naval spent nuclear fuel handling operations at NRF during the post-refurbishment operational period. Additional details on these calculations are provided in Appendix F, Section F.4.2.

Table 4.13-6: Annual Health Effects for Routine Naval Spent Nuclear Fuel Handling Operations During the Post-Refurbishment Period of the Overhaul Alternative

<table>
<tr><th colspan="4">Radiation Exposure to Individuals Outside ECF</th></tr>
<tr><th rowspan="2">Exposed Individual</th><th colspan="2">Dose</th><th rowspan="2">Fatal Cancer[1]
Per Individual</th></tr>
<tr><td>Sievert</td><td>rem</td></tr>
<tr><td>Worker</td><td>1.0×10^{-5}</td><td>1.0×10^{-3}</td><td>4.1×10^{-7}</td></tr>
<tr><td>MCW</td><td>6.9×10^{-10}</td><td>6.9×10^{-8}</td><td>2.8×10^{-11}</td></tr>
<tr><td>MOI</td><td>6.0×10^{-9}</td><td>6.0×10^{-7}</td><td>3.3×10^{-10}</td></tr>
<tr><th colspan="4">Radiation Exposure to the General Population within an 80.5-kilometer (50-mile) Radius of NRF</th></tr>
<tr><td rowspan="2">General Population of approximately 151,000</td><td>person-Sievert</td><td>person-rem</td><th>Fatal Cancer[1] in the General Population</th></tr>
<tr><td>2.0×10^{-4}</td><td>2.0×10^{-2}</td><td>1.1×10^{-5}</td></tr>
<tr><td colspan="4">[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the MOI and General Population. In determining a means of assessing health effects from radiation exposure, the International Commission on Radiological Protection (ICRP) has developed the above factors which include both fatal and non-fatal cancers (ICRP 2007). The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)</td></tr>
</table>

The calculations indicate that there would be a small increase in dose to the public from the post-refurbishment operational period. The small increase in radiation exposure is due entirely to the assumption that the facility would operate at maximum capacity following the refurbishment. The estimated likelihood of developing fatal cancer to the General Population living within an 80.5-kilometer (50-mile) radius of NRF due to radiological emissions from routine naval spent nuclear fuel handling operations (Table 4.13-6) is 1 in 91,000. This likelihood of developing fatal cancer is very low in comparison to the 22,650 individuals (1 in 6.7) living within an 80.5-kilometer (50-mile) radius of NRF that would be expected to die from cancer from a lifetime of normal activity unrelated to NRF radiological emissions (Appendix F, Section F.2.6).

The 2009 baseline radiation exposure from ECF of 9.0 x 10^{-5} person-Sievert (9.0 x 10^{-3} person-rem) (Table 3.13-6) from routine naval spent nuclear fuel handling and examination operations is approximately 2 percent of the 2009 INL population radiation exposure of 5.2 x 10^{-3} person-Sievert (5.2 x 10^{-1} person-rem) (Table 3.13-4). The radiation exposure from examination operations at ECF in 2009 is less than 0.1 percent of the radiation exposure from naval spent nuclear fuel handling operations and has a negligible contribution to total radiation exposure from ECF. Therefore, the increased radiation exposure from routine naval spent nuclear fuel handling operations to the General Population from the post-refurbishment operational period (Table 4.13-6) would increase the ECF baseline radiation exposure resulting in a 2 percent increase to INL population radiation exposures. Therefore, the radiation exposure from the post-refurbishment operational period of the Overhaul Alternative would represent 4 percent of INL radiation exposures.

Figure 4.13-1 provides perspective about the fraction of radiation exposure the MOI would receive from INL and NRF when compared with other common radiation sources. The annual radiation exposure from natural background, medical procedures, and consumer products are provided in Table 3.13-1. The annual radiation exposure due to INL releases is provided in Table 3.13-3, and the annual radiation exposure from NRF during the post-refurbishment operational period is provided in Table 4.13-6.

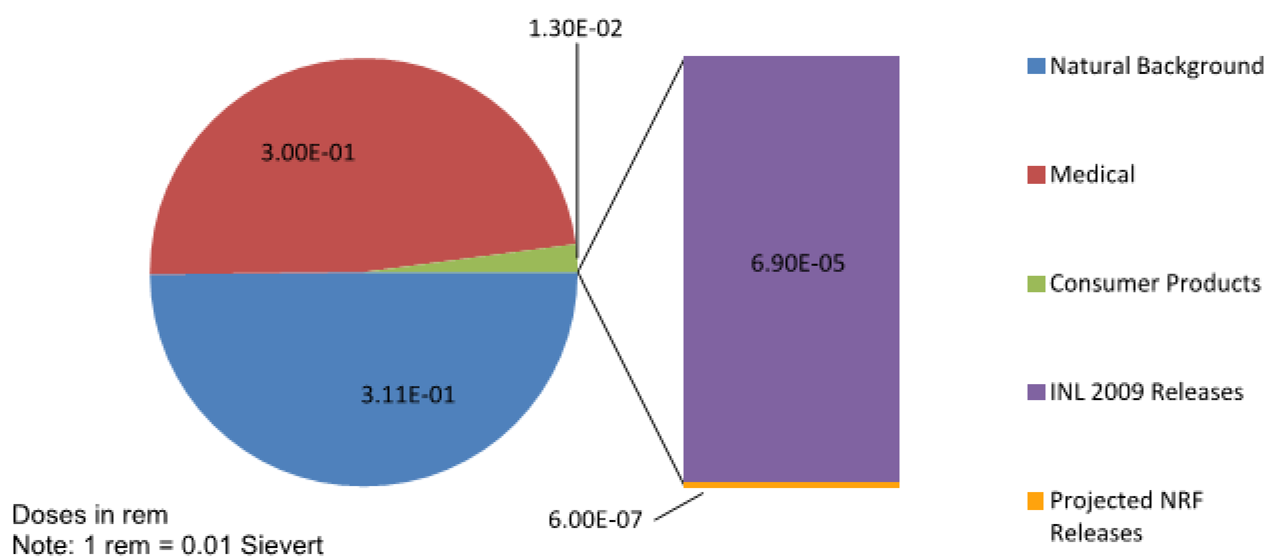


Figure 4.13-1: Sources of Radiation Exposure for the MOI

Figure 4.13-1 demonstrates that the radiation exposure from the post-refurbishment operational period would be negligible compared to annual background radiation exposure. Therefore, there would be no impact to the public from radiological exposures from the post-refurbishment operational period of the Overhaul Alternative.

4.13.2.1.3 New Facility Alternative

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period.

Radiation Exposures to Workers in ECF

During the construction period of the New Facility Alternative, no radiological materials would be involved in the construction of the new facility. Routine maintenance and operations at ECF would continue unchanged during the construction period of the new facility. There would be no increases to radiological health and safety impacts for naval spent nuclear fuel handling workers in ECF from the baseline conditions described in Section 3.13; therefore, there would be no radiological occupational health and safety impact from radiation exposure to workers in ECF for the construction period of the New Facility Alternative.

Radiation Exposures to Workers Outside of ECF

During the construction period, approximately 360 construction workers would be needed annually (Section 4.10). During the construction period of the New Facility Alternative, no radiological materials would be involved in the construction of the new facility and personnel outside of ECF, including construction workers, would not require any radiation exposure monitoring. All construction activities would take place in an area with no radiological contamination.

Due to the location of the construction site outside of ECF on NRF property, the radiation exposure to construction workers from ECF operations would be less than the Worker exposure and greater than the MCW exposure presented in Table 4.13-6. Radiation exposure would be negligible, and there would be no radiological occupational health impact to the construction workforce from routine naval spent nuclear fuel handling operations during the construction period.

The radiation exposure to persons outside of the ECF from the construction period would be similar to the radiation exposure from ECF shown in Table 3.13-5 and Table 3.13-6. Therefore, there would be no public health impact from radiation exposure for the construction period of the New Facility Alternative.

Transition Period

Naval spent nuclear fuel handling operations would transition from ECF to the new facility for a period of 5 to 12 years.

Radiation Exposures to Workers Inside ECF and the New Facility

During the transition period there would be an increase of approximately 60 naval spent nuclear fuel handling workers at NRF (Section 4.10). According to 2010 radiation exposure data for individuals involved in naval spent nuclear fuel handling operations, the highest average annual radiation exposure of 0.00018 Sievert (0.018 rem) was obtained by technicians who unload shipping containers. Therefore, it is estimated that the radiation exposure to a naval spent nuclear fuel handling worker could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.00018 Sievert (0.018 rem). (NNPP 2011b)

The collective increase in dose would be 0.011 person-Sievert (1.1 person-rem), using an average of 0.00018 Sievert (0.018 rem). There would be no impact from radiation exposure to an individual naval spent nuclear fuel handling worker in ECF during the transition period because the individual radiation exposure would not change from the baseline provided in Section 3.13. However, the collective impact from radiation exposure to naval spent nuclear fuel handling workers would be small during the transition period because of the increase in naval spent nuclear fuel handling workers at NRF.

Radiation Exposures to Individuals Outside ECF and the New Facility

During the transition period of the New Facility Alternative, the new facility and ECF would operate in parallel to unload M-140 shipping containers, unload M-290 shipping containers, and load naval spent nuclear fuel canisters to meet the needs of the naval nuclear fleet and the terms of SA 1995 and SAA 2008. However, the production rates during the transition period would be bounded by the maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters in the new facility. The radiological exposure to individuals outside ECF and the new facility from performing naval spent nuclear fuel handling operations at maximum capacity is described below.

Table 4.13-7 presents the radiation exposure and health effects (fatal cancer) to individuals outside ECF and the new facility from routine naval spent nuclear fuel handling operations at NRF during the transition period. Additional details on these calculations are provided in Appendix F, Section F.4.2.

Table 4.13-7: Annual Health Effects for Routine Naval Spent Nuclear Fuel Handling Operations During the Transition Period of the New Facility Alternative

Radiation Exposure to Individuals Outside ECF or New Facility			
Exposed Individual	**Dose**		**Fatal Cancer[1] Per Individual**
	Sievert	rem	
Worker	1.0×10^{-5}	1.0×10^{-3}	4.1×10^{-7}
MCW	6.9×10^{-10}	6.9×10^{-8}	2.8×10^{-11}
MOI	6.0×10^{-9}	6.0×10^{-7}	3.3×10^{-10}
Radiation Exposure to the General Population within an 80.5-kilometer (50-mile) Radius of NRF			
General Population of approximately 151,000	person-Sievert	person-rem	**Fatal Cancer[1] in the General Population**
	2.0×10^{-4}	2.0×10^{-2}	1.1×10^{-5}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the MOI and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers (ICRP 2007). The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population, and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

The calculations indicate that there would be a small increase in dose to the public from the transition period. The small increase in radiation exposure is due entirely to the assumption that ECF and the new facility would operate in parallel at maximum capacity during the transition period. The estimated likelihood of fatal cancer to the General Population living within an 80.5-kilometer (50-mile) radius of NRF due to radiological emissions from routine naval spent nuclear fuel handling operations (Table 4.13-7) is 1 in 91,000. This likelihood of developing fatal cancer is very low in comparison to the 22,650 individuals (1 in 6.7) living within an 80.5-kilometer (50-mile) radius of NRF that would be expected to die from cancer from a lifetime of normal activity unrelated to NRF radiological emissions (Appendix F, Section F.2.6).

The 2009 baseline radiation exposure from ECF of 9.0×10^{-5} person-Sievert (9.0×10^{-3} person-rem) (Table 3.13-6) from routine naval spent nuclear fuel handling and examination operations is approximately 2 percent of the 2009 INL population radiation exposure of 5.2×10^{-3} person-Sievert (5.2×10^{-1} person-rem) (Table 3.13-4). The radiation exposure from examination operations at ECF in 2009 was less than 0.1 percent of the radiation exposure from naval spent nuclear fuel handling operations and has a negligible contribution to total radiation exposure from ECF. Therefore, the increased radiation exposure from routine naval spent nuclear fuel handling operations to the General Population from the transition period (Table 4-13.7) would increase the ECF baseline radiation exposure resulting in a 2 percent increase to INL population radiation exposures. Therefore, the radiation exposure from the transition period of the New Facility Alternative would represent 4 percent of INL radiation exposures. See Figure 4.13-1 for perspective about the fraction of radiation exposure the MOI receives from INL and NRF when compared with other common radiation sources.

The radiation exposure during the transition period would be negligible compared to annual background radiation exposure. Therefore, there would be no impact to the public from radiological exposures from the transition period of the New Facility Alternative.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF.

<u>Radiation Exposures to Workers Inside ECF and the New Facility</u>

There would be a decrease of approximately 60 naval spent nuclear fuel handling workers during the new facility operational period (Section 4.10). According to 2010 radiation exposure data for individuals involved in naval spent nuclear fuel handling operations, the highest average annual radiation exposure of 0.00018 Sievert (0.018 rem) was obtained by technicians who unload shipping containers. Therefore, it is estimated that the dose to a naval spent nuclear fuel handling worker could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.00018 Sievert (0.018 rem). (NNPP 2011b)

The collective decrease in dose would be 0.011 person-Sievert (1.1 person-rem), using an average of 0.00018 Sievert (0.018 rem). There would be no impact from radiation exposure to an individual naval spent nuclear fuel handling worker in ECF during the new facility operational period because the individual radiation exposure would not change from the baseline provided in Section 3.13. However, the collective beneficial impact from radiation exposure to naval spent nuclear fuel handling workers would be small during the new facility operational period because of the decrease in naval spent nuclear fuel handling workers at NRF.

<u>Radiation Exposures to Workers Outside ECF and the New Facility</u>

During the new facility operational period, the new facility would operate at maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters to meet the needs of the naval nuclear fleet and the terms of SA 1995 and SAA 2008. The radiological exposure to individuals outside ECF from performing naval spent nuclear fuel handling operations at maximum capacity would be the same as those presented in Table 4.13-7. The small increase in radiological exposure from the 2009 ECF baseline radiation exposure is due entirely to the assumption that the new facility would operate at maximum capacity during the operational period.

The 2009 baseline radiation exposure from ECF of 9.0 x 10^{-5} person-Sievert (9.0 x 10^{-3} person-rem) (Table 3.13-6) from routine naval spent nuclear fuel handling and examination operations is approximately 2 percent of the 2009 INL population radiation exposure of 5.2 x 10^{-3} person-Sievert (5.2 x 10^{-1} person-rem) (Table 3.13-4). The radiation exposure from examination operations at ECF in 2009 was less than 0.1 percent of the radiation exposure from naval spent nuclear fuel handling operations and has a negligible contribution to total radiation exposure from ECF. Therefore, the increased radiation exposure from routine naval spent nuclear fuel handling operations to the General Population from the new facility operational period (Table 4.13-7) would increase the ECF baseline radiation exposure resulting in a 2 percent increase to INL population radiation exposures. Therefore, the radiation exposure from the new facility operational period would represent 4 percent of INL radiation exposures. See Figure 4.13-1 for perspective about the fraction of radiation exposure the MOI receives from INL and NRF when compared with other common radiation sources.

The radiation exposure from the new facility operational period would be negligible compared to annual background radiation exposure. Therefore, there would be no impact to the public from radiological exposures from the operational period of the New Facility Alternative.

4.13.2.2 Hypothetical Accident and IDA Scenario Radiation Exposures

Hypothetical accidents and IDA scenarios for naval spent nuclear fuel handling operations are evaluated. Accident scenario descriptions and radiation exposure results are described in Appendix F, Section F.5.

As described in Section 3.13, the NNPP safety strategy provides robust protection to the public, workers, and the environment against the effects of ionizing radiation and radioactive contamination resulting from naval spent nuclear fuel work performed at NRF. For naval spent nuclear fuel handling the NNPP applies principles of defense-in-depth, safety-in-design, and a graded approach to safety. Although the NNPP safety strategy provides robust protection, the consequences and risks from accidents in the hypothetical events if these controls and features were to fail, is presented in this section.

The naval spent nuclear fuel handling operations would not differ significantly between the time periods associated with the alternatives. In general, the hypothetical accident evaluations apply to all alternatives with the following exceptions. When necessary, the hypothetical accident scenarios account for the differences in the water pool structure between alternatives. For the drained water pool scenario, the probability varies between alternatives. For the minor water pool leak scenario, the consequence varies between alternatives. The impacts of the inter-facility transport accident scenario apply only to the New Facility Alternative because transportation between facilities of naval spent nuclear fuel for examination would only be applicable if a new facility is constructed. For the No Action Alternative where the risks are presented consistent with the other alternatives, the risks may be conservative because the No Action Alternative does not support unloading M-290 shipping containers.

Since Location 3/4 and Location 6 are in close proximity to one another, the differences in weather and distance for the alternatives have no effect on the analysis results.

The radiological impacts of hypothetical accidents associated with naval spent nuclear fuel handling operations are presented below. Details about the analysis methods and assumptions for these radiation exposure calculations are provided in Appendix F, Section F.3. For these evaluations, impacts to several individuals and the General Population are calculated. Radiation exposures are modeled for various individuals or groups of people, based on expected activities and behaviors of the individual or group following an accident.

1) Worker - The Worker is an adult individual located 100 meters (330 feet) from the radioactive material release point. The Worker is an NRF employee walking by or working near the naval spent nuclear fuel handling facility or accident location that is not directly involved in the accident scenario (i.e., an uninvolved worker).

2) Maximally Exposed Co-Located Worker (MCW) - The MCW is an adult worker at another independent INL facility (separate from NRF). The MCW used for this analysis is located 8 kilometers (5 miles) away from NRF at the ATR Complex.

3) Maximally Exposed Off-Site Individual (MOI) - The MOI is an adult member of the public who could potentially be living at the nearest INL property boundary. The MOI is treated as a full-time resident, and receives the maximum possible radiation exposure to the general public. The MOI is located 10.5 kilometers (6.5 miles) away from NRF in the WNW direction.

4) Nearest Public Access (NPA) - The NPA is a member of the public who may be inside the INL boundary when an accident occurs. The NPA is defined as a member of the public stranded on a public highway within the INL boundary during an accident. The closest NPA is located 14 kilometers (8.7 miles) away from NRF in the southwest (SW) direction.

5) General Population - The General Population is the public that resides at various distances beyond the INL boundary. The General Population downwind dose radiation exposure following an accident is evaluated in 16-kilometer (10-mile) radial increments from the facility, out to a radius of 80.5 kilometers (50 miles) in each of the 16 compass sectors (e.g., N, NNE, NE) to account for the population distribution (age and locations). The population distribution is shown in Figure 3.10-2; age distribution is addressed in Appendix F, Section F.3.

The radiation exposures to the refurbishment workers during the refurbishment period and construction workers during the construction period are not explicitly modeled. However, for the refurbishment period of the Overhaul Alternative, the consequences to a refurbishment worker in ECF during an accident would be between the consequences to involved workers discussed in Appendix F on the high end and the consequences to the Worker who is 100 meters (330 feet) away for the affected facility on the low end. For the construction period of the New Facility Alternative, the consequences to the construction workers would be between the consequences to the Worker who is 100 meters (330 feet) away from the affected facility on the high end and the consequences to the MCW located at the ATR Complex on the low end.

The radiation exposure calculations include the radioactive particles or gases released into the atmosphere or into the aquifer from accident scenarios via three pathways: airborne, waterborne, and direct radiation. Airborne contributions to dose are determined using an air dispersion modeling code (RSAC-7) by calculating the doses attributable to air immersion, inhalation, ingestion, and ground shine (radiation from radionuclides deposited on the ground). The waterborne radiation exposure is calculated by assuming airborne emissions are deposited onto surface water or the ground surface. Those particulates assumed to deposit on the ground surface are modeled to travel to the aquifer. Waterborne contributions to radiation exposure are determined using the GENII modeling software to calculate the doses attributable to water immersion and ingestion (of both water and contaminated foods). Direct radiation contributions are determined for accidents that involve a loss of shielding, such as loss of water in the water pool.

Radiological accident analysis is performed for a range of accidents (consequence and probability) and IDAs that cover the extent of naval spent nuclear fuel handling operations. Refer to Appendix F, Section F.5 for a description of the accidents and IDAs. Initiating events are reviewed including natural phenomena (earthquakes, volcanic activity, tornadoes, hurricanes, and other natural events) and human initiated events (human error, equipment failures, fires, explosions, plane crashes, transportation accidents, and sabotage). Guiding principles were established for the scenario development including the form of radioactive materials and the manner in which they are released and dispersed into the environment.

- Release of radioactive materials to the environment due to overheating of naval spent nuclear fuel
- Release of radioactive materials to the environment due to mechanical shock, damage, or inadvertent breaching of fuel cladding or containment

Appendix F describes 12 hypothetical scenarios and IDAs selected to be representative of naval spent nuclear fuel handling operations. These hypothetical sequences of events include a HEPA filter fire, a shielded transfer container drop or tip-over, an airplane crash into the water pool, a drained water pool, a hydrogen detonation in the water pool, mechanical damage to naval spent nuclear fuel in the water pool, an inter-facility transport accident, inadvertent cutting of naval spent nuclear fuel in the water pool, an inadvertent criticality in the water pool, a shielded basket transfer container drop or tip-over, a windborne projectile into a shielded basket transfer container, and a minor water pool leak. The minor water pool leak is predominantly evaluated qualitatively because of the many variables and associated uncertainties in the scenario and the low consequences expected if a minor water pool leak were to occur. The scenarios are discussed in Appendix F, Section F.5.4 and the radiation exposures and health effects are summarized in Appendix F, Section F.5.5.

Acts of terrorism or acts of sabotage are referred to as IDAs. IDAs are not accidents; they are intentional and limited only by the ingenuity of the perpetrator. Nevertheless, environmental consequences could result from a given IDA. Therefore, in addition to accidents, IDAs are also considered. These IDAs are not considered to be “accidents” because the event would be intentional. Although any accident could possibly be caused by an IDA, the IDAs discussed are unlikely to result from natural phenomena, human error, or equipment failure and require intentional intervention to initiate the scenario. IDAs are expected to result in consequences similar to the results of some evaluated accidents. For IDAs, consequences (i.e., dose) are presented. Risk calculations are not completed for these scenarios because the probability of the event is considered “unknowable” (DOE 2004b).

The inter-facility transport accident scenario and the airplane crash into the water pool scenario are treated as IDAs only, and no probability of occurrence or resultant risk is calculated. Based on the slow travel speeds, short travel distance across NRF property, and infrequent assembly transfers, the inter-facility transport accident scenario is not considered reasonably foreseeable without intentional human intervention. Similarly, because of the low level of commercial air traffic across NRF, distance from airports, and relatively small target footprint for a naval spent nuclear fuel handling facility, the airplane crash into the water pool is not considered reasonably foreseeable without intentional human intervention. For simplicity, the description of methodology for calculation of consequences from accident scenarios is applicable to IDAs.

NRF integrates safety and security safeguards to deter, detect, delay, assess, and respond to security threats which could lead to an IDA. Although IDAs cannot be categorically ruled out, appropriate security measures would be taken to lessen the chance of occurrence. These measures include security clearances for personnel, restricted access to areas containing radioactive material, and physical barriers to the facility. If an IDA were to occur at NRF, having additional measures in place (e.g., HEPA filtered ventilation systems, fire protection systems, emergency response capabilities, and the remote location of NRF) would lessen the consequences.

The contribution to dose due to radiological accidents is evaluated for airborne, waterborne, and direct radiation as described above using dose assessment tools. Two different weather conditions (i.e., a 50 percent and a 95 percent condition) are evaluated for accident conditions, based on wind speed and stability class for 16 radial directions. The 50 percent condition represents the average meteorological condition, defined as that condition for which more severe conditions with respect to accident consequences are not exceeded more than 50 percent of the time. The 95 percent condition represents the meteorological conditions which could produce the highest calculated radiation exposures, defined as that condition which is not exceeded more than 5 percent of the time or is the worst combination of weather stability class and wind speed with respect to accident consequences. The results of the 50 percent condition are presented in this section since they are considered representative. Appendix F contains results from the 95 percent condition along with additional detail regarding the methodology used for radiological accident analysis.

The probabilities that the hypothetical accidents could occur are described in Appendix F. The probabilities assigned to the events reflect the likelihood that a particular event, such as an earthquake, might occur. However, for the purposes of analyses, the resulting accident is assumed to have severe consequences and various features that would reduce the likelihood and consequences of the accident are conservatively omitted. Features such as the ruggedness of naval spent nuclear fuel and fuel containers, passive restraints to prevent tipping, NNPP material controls, engineering controls and inspections, testing, and operator training and oversight would reduce the probability the initiating event would occur. As a result, the annual risks stated are believed to be larger than the annual risks that would be associated with actual accidents. Appendix F, Section F.7.1 provides additional information about event probabilities.

The results for the hypothetical accidents and IDAs are summarized in Table 4.13-8 and Table 4.13-9. These results are calculated using the methods described in Appendix F.

For the hypothetical accident scenarios and IDAs evaluated, the impacts to the Worker, MCW, NPA, MOI, and General Population all result in a small likelihood of developing fatal cancer from radiation exposure. The hypothetical accident scenario that results in the highest annual risk is a drained water pool; the IDA that results in the highest consequence is the inter-facility transport accident. If these hypothetical scenarios were to occur, the likelihood of fatal cancer for the Worker, MCW, NPA, MOI, and General Population is small.

For perspective, the average American's risk of dying from cancer from normal activity is 0.15, or 1 chance in 6.7, over his or her lifetime. Using this probability of 1 chance in 6.7, approximately 22,650 cancer fatalities would be expected in the General Population in the 80.5-kilometer (50-mile) radius surrounding NRF (approximately 151,000 people) during a lifetime of normal activity unrelated to NRF emissions (Appendix F, Section F.2.6).

For accident scenarios, the likelihood of fatal cancer for the Worker, MCW, NPA, and MOI is presented (Table 4.13-8), and the annual risk of developing fatal cancer is presented for the General Population (Table 4.13-9). The annual risk of developing fatal cancer in the General Population (fatal cancer in the General Population multiplied by the annual probability of the accident) from a drained water pool is 1 chance in 36,000 (No Action Alternative), 1 chance in 360,000 (Overhaul Alternative), or 1 chance in 520,000 (New Facility Alternative). There would be no impact on the Worker, MCW, NPA, MOI (Table 4.13-8) or the General Population (Table 4.13-9) because the increased likelihood of fatal cancer from the accident is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities; therefore, there would be no human health impact from radiological exposures from naval spent nuclear fuel handling accident scenarios.

For IDAs, annual risk calculations are not completed because the probability of the event is considered “unknowable” (DOE 2004b). However, consequences (likelihood of fatal cancer) are presented for the Worker, MCW, NPA, and MOI (Table 4.13-8) and General Population (Table 4.13-9). The number of fatal cancers in the General Population from an inter-facility transport accident scenario would increase by 0.52 (less than one instance of fatal cancer in 151,000 people). This increase in developing fatal cancer, if the IDA were to occur, would be added to the 22,650 fatal cancers expected in the General Population from lifetimes of normal activity. There would be no impact on the Worker, MCW, NPA, MOI (Table 4.13-8) or the General Population (Table 4.13-9) because the increased likelihood of fatal cancer if this IDA were to occur is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities; therefore, there would be no human health impact from radiological exposures from the IDA scenarios evaluated.

Table 4.13-8: Impact on Individuals From Hypothetical Naval Spent Nuclear Fuel Handling Accident Scenarios

Accident Scenario Description	Exposed Individual							
	Worker		MCW		NPA		MOI	
	Dose rem[1]	Fatal Cancer[2]	Dose rem[1]	Fatal Cancer[2]	Dose rem[1]	Fatal Cancer[2]	Dose rem[1]	Fatal Cancer[2]
HEPA Filter Fire	5.5×10^{-7}	2.3×10^{-10}	3.6×10^{-10}	1.5×10^{-13}	2.8×10^{-10}	1.5×10^{-13}	2.1×10^{-9}	1.2×10^{-12}
Shielded Transfer Container Drop or Tip-Over	1.6×10^{-2}	6.6×10^{-6}	1.1×10^{-5}	4.3×10^{-9}	6.5×10^{-6}	3.6×10^{-9}	1.0×10^{-5}	5.6×10^{-9}
Airplane Crash into Water Pool	9.7×10^{-2}	4.0×10^{-5}	8.0×10^{-5}	3.3×10^{-8}	3.6×10^{-5}	2.0×10^{-8}	2.6×10^{-4}	1.5×10^{-7}
Drained Water Pool	2.3	9.6×10^{-4}	8.7×10^{-4}	3.6×10^{-7}	6.6×10^{-4}	3.6×10^{-7}	5.1×10^{-3}	2.8×10^{-6}
Hydrogen Detonation in Storage Container in the Water Pool	7.1×10^{-3}	2.9×10^{-6}	4.7×10^{-6}	1.9×10^{-9}	2.9×10^{-6}	1.6×10^{-9}	8.0×10^{-6}	4.4×10^{-9}
Mechanical Damage to Fuel in the Water Pool	2.4×10^{-4}	1.0×10^{-7}	2.0×10^{-7}	8.2×10^{-11}	9.0×10^{-8}	5.0×10^{-11}	6.5×10^{-7}	3.6×10^{-10}
Inter-Facility Transport Accident	13	5.3×10^{-3}	8.5×10^{-3}	3.5×10^{-6}	2.8×10^{-3}	1.5×10^{-6}	1.0×10^{-1}	5.5×10^{-5}
Inadvertent Fuel Cutting in the Water Pool	4.9×10^{-4}	2.0×10^{-7}	4.0×10^{-7}	1.6×10^{-10}	1.8×10^{-7}	9.9×10^{-11}	1.3×10^{-6}	7.2×10^{-10}
Inadvertent Criticality in the Water Pool	4.8	2.0×10^{-3}	6.2×10^{-3}	2.6×10^{-6}	1.8×10^{-3}	9.7×10^{-7}	2.4×10^{-2}	1.3×10^{-5}
Shielded Basket Transfer Container Drop or Tip-Over	9.6×10^{-2}	3.9×10^{-5}	6.3×10^{-5}	2.6×10^{-8}	3.8×10^{-5}	2.1×10^{-8}	5.5×10^{-5}	3.0×10^{-8}
Windborne Projectile into Shielded Basket Transfer Container	1.2×10^{-3}	4.7×10^{-7}	7.6×10^{-7}	3.1×10^{-10}	5.9×10^{-7}	3.3×10^{-10}	4.5×10^{-6}	2.5×10^{-9}

Note: Results are for 50 percent meteorology.

[1] 1 rem = 0.01 Sievert.

[2] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the MOI and NPA. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers (ICRP 2007). The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)

Table 4.13-9: General Population Impacts From Hypothetical Naval Spent Nuclear Fuel Handling Accident Scenarios

Accident Scenario	General Population Dose person-rem[1]	Fatal Cancer in the General Population per Accident[2]	Annual Probability of Accident[3]	Annual Risk of Developing Fatal Cancer to the General Population[5]
HEPA Filter Fire	2.1×10^{-5}	1.1×10^{-8}	5.0×10^{-4}	5.7×10^{-12}
Shielded Transfer Container Drop or Tip-Over	9.7×10^{-2}	5.3×10^{-5}	2.7×10^{-3}	1.4×10^{-7}
Airplane Crash into Water Pool[4]	3.3	1.8×10^{-3}	NA	NA
Drained Water Pool – No Action Alternative	5.0×10^{1}	2.8×10^{-2}	1.0×10^{-3}	2.8×10^{-5}
Drained Water Pool – Overhaul Alternative	5.0×10^{1}	2.8×10^{-2}	1.0×10^{-4}	2.8×10^{-6}
Drained Water Pool – New Facility Alternative	5.0×10^{1}	2.8×10^{-2}	7.0×10^{-5}	1.9×10^{-6}
Hydrogen Detonation in the Water Pool	7.8×10^{-2}	4.3×10^{-5}	6.4×10^{-5}	2.7×10^{-9}
Mechanical Damage to Fuel in the Water Pool	8.1×10^{-3}	4.4×10^{-6}	2.7×10^{-4}	1.2×10^{-9}
Inter-Facility Transport Accident[4]	9.4×10^{2}	5.2×10^{-1}	NA	NA
Inadvertent Fuel Cutting in the Water Pool	1.6×10^{-2}	8.9×10^{-6}	4.0×10^{-4}	3.5×10^{-9}
Inadvertent Criticality in the Water Pool	2.1×10^{2}	1.1×10^{-1}	1.5×10^{-6}	1.7×10^{-7}
Shielded Basket Transfer Container Drop or Tip-Over	5.3×10^{-1}	2.9×10^{-4}	3.5×10^{-4}	1.0×10^{-7}
Windborne Projectile into Shielded Basket Transfer Container	4.3×10^{-2}	2.4×10^{-5}	3.3×10^{-5}	7.9×10^{-10}

Note: Results are for 50 percent meteorology.
[1] 1 person-rem = 0.01 person-Sievert.
[2] To convert dose to fatal cancer, a factor of 5.5×10^{-4} is multiplied by the dose for the General Population (ICRP 2007). In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Appendix F, Section F.2.5)
[3] The probability of the accident is conservative. (Appendix, F Section F.7.1)
[4] No probability or annual risk is calculated for IDAs because the probability of the event is considered “unknowable” (DOE 2004b).
[5] The lifetime risk of developing fatal cancer is determined by multiplying the annual risk of developing fatal cancer by the expected time-frame of the alternative.

Minor Water Pool Leak

In addition to the hypothetical accident scenarios described above, a minor water pool leak scenario is evaluated. Information about water pool leaks from commercial spent nuclear fuel pools is described in Appendix F, Section F.5.4.12. Unlike other accident scenarios which involve events that are acute and self-evident, a minor water pool leak might persist for some time before discovery (NRC 2006). Combinations of factors including the type of radiological contaminants, sorption by the concrete walls of the water pool, hydrologic and chemical processes in the environment, and groundwater monitoring at NRF minimize the likelihood that a water pool leak would result in noticeable off-site environmental impacts. Based on these factors, the potential for a minor water pool leak to significantly impact the environment would be small. Nonetheless, the impact of a water pool leak three times larger than the leak assumed in a commercial industry assessment (NRC 2013) is evaluated and compared to natural background radiation.

<u>No Action Alternative and Overhaul Alternative (Refurbishment Period)</u>

The ECF water pool surfaces are covered with a fiberglass or epoxy coating which serves as an extra barrier to water leakage. Over the next 40 years, preventative and corrective maintenance may not be sufficient to sustain the proper functioning of ECF infrastructure and equipment. Additionally, the ECF water pool does not have a liner, creating the potential for water infiltration into the reinforced concrete structure and the potential for corrosion damage of the reinforcing bar within the structure. The capability to detect and collect small leaks, a common feature in modern water pools, is not present for the ECF water pool. However, groundwater monitoring is performed at NRF making it unlikely that leakage from the water pool would remain undetected for an extended period of time.

If a leak were to occur under the No Action Alternative, it is estimated that the MOI peak annual dose would be 7.6×10^{-6} rem, which is less than 0.0025 percent of the annual dose from natural background radiation. This is based on a leak rate of 300 gallons per day with a 40-year duration. Additionally, the concentration of radionuclides in the water at the location of an individual member of the public would be much lower than the EPA MCLs for drinking water (Section 3.4). Therefore, the resulting impact on public health and safety from a minor water pool leak would be negligible in comparison to the amount of natural background radiation received by individuals annually. Because the increased likelihood of fatal cancer from the accident is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities, there would be no human health impact from radiological exposures from the minor water pool leak scenario. Appendix F, Section F.5.4.12 provides additional details regarding the impacts of a minor water pool leak scenario.

<u>Overhaul Alternative (Post-Refurbishment Operational Period) and New Facility Alternative</u>

The water pool for both the Overhaul Alternative and the New Facility Alternative would be lined to form a water-tight barrier between the water in the water pool and the concrete walls of the water pool. Lessons learned from previous studies of water pool leaks would be considered in the designs for the new facility water pool or refurbishment. This hypothetical accident scenario qualitatively evaluates the impacts of a leak that develops in the water-tight barrier of the water pool resulting in a discharge of water pool water to the environment. A groundwater monitoring system would actively monitor the site for leaks. It is expected that the combination of the water pool liner, concrete walls, and groundwater monitoring would prevent water pool water from leaking, undetected, into the environment. Further, the integrity of the water pool liner and structure would be ensured by maintaining a low-corrosive environment in the water pool water through proper water chemistry control.

If a leak were to occur in the Overhaul Alternative or New Facility Alternative water pool, it is estimated that the MOI peak annual dose from a leak would be 2.4×10^{-6} rem, which is less than 0.00077 percent of the annual dose from natural background radiation. This is based on a leak rate of 300 gallons per day with a 5-year duration. Additionally, the concentration of radionuclides in the water at the location of an individual member of the public would be much lower than the EPA MCLs for drinking water (Section 3.4). Therefore, the resulting impact on public health and safety from a minor water pool leak would be negligible in comparison to the amount of natural background radiation received by individuals annually. Because the increased likelihood of fatal cancer from the accident is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities, there would be no human health impact from radiological exposures from the minor water pool leak scenario. Appendix F, Section F.5.4.12 provides additional details regarding the impacts of a minor water pool leak scenario.

Emergency Preparedness

Emergency preparedness to prevent and respond to accident and IDA scenarios is described in Appendix F, Section F.6. Emergency plans are in effect at NRF to ensure that workers and the public would be properly protected in the event of an accident. These response plans include the activation of emergency response teams provided by NRF or INL and an NRF emergency control center, as well as activation of a command and control network with NNPP Headquarters and supporting laboratories. The long-standing emergency planning program that exists within the NNPP includes the ability to utilize the comprehensive and extensive emergency response resources of each NNPP site and provides for coordination with appropriate civil authorities. In addition to the NNPP resources, extensive federal emergency response resources are available, as needed, to support state or local response.

Emergency response measures include provisions for immediate response to radiological emergencies at the facility location, identification of the accident conditions, communications with those providing radiological data, and recommendations for any appropriate protective actions. NRF employees are trained to respond to radiological emergencies including evacuation from areas that involve a potential release of radioactive material. In the event of an accident involving radioactive materials, workers in the vicinity of the accident would promptly leave the immediate area, typically within minutes of the accident.

Planning for emergencies is based on NNPP technical analysis as well as recommendations and guidance provided by numerous agencies experienced in emergency planning including the Department of Homeland Security (Federal Emergency Management Agency), the U.S. Navy, DOE, NRC, EPA, National Council on Radiation Protection and Measurements, and the International Atomic Energy Agency. Emergency planning for the public is based on the above-mentioned guidance as well as the specific planning requirements of local civil authorities. NNPP maintains close relationships with civil authorities to ensure that communications and emergency responses are coordinated if ever needed. (NNPP 2014)

Regularly scheduled exercises are conducted to test NRF's ability to respond to accidents. These exercises include realistic tests of people, equipment, and communications involved in all aspects of the plans; the plans are regularly reviewed and modified to incorporate experience gained from the exercises. These exercises also periodically include steps to verify the adequacy of interactions with local hospitals, emergency personnel, and state officials.

4.14 Waste Management

This section discusses the potential waste management impacts from the proposed action. No new waste streams would be introduced for the proposed action. Also, no new federal or state waste permits would be needed, and the NNPP would comply with applicable state and federal waste management requirements (as identified in Section 3.14 and Appendix C) during waste management activities. The ROI for waste management activities encompasses the INL, including NRF.

Any increase in waste generation is considered an impact. Factors that contribute to the significance of a waste stream's impact include if waste could potentially be generated prior to a disposal pathway being identified, or if the waste disposal facilities' capacities could be exceeded with the addition of waste from the proposed action. The alternatives are analyzed by estimating the types and quantities of wastes to be generated and comparing these against 5-year average annual generation rates at NRF (baseline information located in Chapter 3, Tables 3.14-2 through 3.14-6) to determine if there is an increase in waste generation. In addition, based on the estimated volumes and generation rates for the alternatives, existing disposal pathways and capacities are evaluated. Increases in waste generation are considered small impacts provided a disposal pathway is in place with required capacity.

Waste Disposal Capacities

The following information about available disposal capacities is presented here because it is applicable to the evaluation of more than one alternative.

In 2010, the remaining capacity of the INL CFA Landfill Complex was 3.4 million cubic meters (4.5 million cubic yards). Due to the large remaining capacity, the capacity of the INL CFA Landfill Complex would not be exceeded from non-hazardous solid waste generated from any of the alternatives. Recyclable materials do not impact a disposal facility's capacity.

RWMC expects to stop accepting RH LLW when it reaches full capacity. DOE is planning to build a replacement facility at INL that will support NNPP RH LLW disposal needs. During the planning of the new DOE RH LLW disposal facility, NRF, the ATR Complex, and the Materials and Fuels Complex (MFC) provided estimates of disposal volumes for the next 20 years to help develop the design capacity. NRF estimated that approximately 90 cubic meters (120 cubic yards) of RH LLW would be shipped annually. Since the design capacity of the facility accounts for NRF projections, the capacity of the facility would be sufficient.

Commercial waste disposal facilities' capacities for LLW are not expected to be exceeded. In 2010, the remaining capacity for the current contracted disposal facility for CH LLW was 900,000 cubic meters (1.2 million cubic yards). For MLLW, which contains both radioactive and RCRA hazardous waste, and for radioactive TSCA waste, the remaining capacity was 300,000 cubic meters (400,000 cubic yards). The total permitted capacity for the contracted disposal facility which receives RCRA hazardous and TSCA waste is 1.4 million cubic meters (1.8 million cubic yards) and 900,000 cubic meters (1.2 million cubic yards), respectively. This does not take into account the waste which is incinerated. Also, if one of the commercial disposal facilities currently used reaches capacity, NRF would establish a contract with a different existing facility, or a new commercial facility would be available as a replacement.

4.14.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

During ECF operations or if ECF operations cease, there would be no new waste management activities that generate non-hazardous solid waste, recyclable materials, RCRA hazardous waste, TSCA waste, solid LLW, radioactive TSCA and radioactive asbestos waste, MLLW, or liquid LLW.

During ECF operations, there would be no change to the waste volumes provided in Section 3.14.

If ECF operations cease, there could be some reductions in waste volumes provided in Section 3.14.

Therefore, there would be no waste generation impact associated with the No Action Alternative.

4.14.2 Overhaul Alternative

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. During the refurbishment period, the naval spent nuclear fuel handling areas of ECF would be refurbished as described in Chapter 2. Waste associated with this work would include equipment removed from the water pool, personal protective equipment (e.g., booties, coveralls, hoods, and gloves), and materials used to minimize the spread of contamination. Waste generated from refurbishment activities is collectively referred to as decontamination and decommissioning (D&D) waste.

Non-radioactive TSCA waste (containing polychlorinated biphenyls (PCBs)) would not be generated during the refurbishment period. ECF is a radiological facility; those areas where TSCA waste is generated would likely be in a radiological area within ECF, and such waste would be managed as radioactive TSCA waste.

Summaries are provided below for the types and volumes of waste estimated to be generated during the refurbishment period of the Overhaul Alternative. These annual generation rates include waste from refurbishment and ECF operations that occur in parallel over the 33-year refurbishment period. Comparisons are also included of annual waste generation rates during the refurbishment period of the Overhaul Alternative and the sum of the NRF routine and D&D annual waste generation rates provided in Section 3.14.

The annual waste generation rates for the refurbishment period of the Overhaul Alternative are conservative values, representative of projected waste generation at NRF from all activities, not just naval spent nuclear fuel handling. The annual waste generation rates for NRF that are used for comparative purposes are based on annual average waste generation rates from 2005 to 2009.

<u>Solid LLW</u>

The solid CH and RH LLW average annual generation rate for activities performed during the refurbishment period of the Overhaul Alternative is estimated to be 3550 cubic meters (4640 cubic yards), which is approximately 85 percent higher than the annual NRF solid LLW generation rate for combined routine and D&D work (Section 3.14.4). This increase in generation would result in approximately one additional truck shipment of solid LLW per day over the baseline. The increase in the estimated annual solid LLW generation rate over the current small generation rate for this waste stream is primarily from the refurbishment activities. Some of the solid LLW generated during refurbishment would be recycled; however, the volume of radioactive material that would be recycled cannot be estimated prior to generation. Even though the annual generation rate of solid LLW would exceed the annual solid LLW generation rate provided in Section 3.14.4, impacts from the generation of solid LLW during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

MLLW

The MLLW average annual generation rate for activities performed during the refurbishment period of the Overhaul Alternative is estimated to be 170 cubic meters (230 cubic yards), which is approximately 750 percent higher than the annual NRF MLLW generation rate for D&D work (Section 3.14.3). NRF does not generate MLLW from routine naval spent nuclear fuel handling operations. This increase in generation would not result in any increases to the baseline in the annual number of shipments of MLLW. Even though the annual generation rate of MLLW would exceed the annual MLLW generation rate provided in Section 3.14.3, impacts from the generation of MLLW during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

Non-Hazardous Solid Waste and Recyclable Materials

The additional 180 refurbishment workers supporting the refurbishment period of the Overhaul Alternative would generate approximately 700 cubic meters (900 cubic yards) of non-hazardous solid waste and recyclable materials annually. This is a conservative estimate based on historic average annual generation of this waste stream from personnel working predominantly at ECF.

Conservatively assuming all of this waste is non-hazardous solid waste for comparative purposes, this would result in an approximate 10 percent increase in the average annual rate of non-hazardous solid waste generated at NRF (Section 3.14.1). This increase in generation would not result in any increases to the baseline in the annual number of shipments of non-hazardous solid waste and recyclable materials. Impacts from the generation of non-hazardous solid waste and recyclable material during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

Radioactive TSCA (PCB) and Radioactive Asbestos Waste

The average annual generation rate of radioactive TSCA waste (PCBs) for activities performed during the refurbishment period of the Overhaul Alternative is estimated to be 3.4 cubic meters (4.4 cubic yards). This represents an increase of approximately 14 percent over the annual NRF radioactive TSCA waste generation rate (Section 3.14.2). This would not result in any increase to the baseline in the annual number of shipments of radioactive TSCA (PCB) waste. Impacts from the generation of radioactive TSCA (PCB) waste during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

The average annual generation rate of radioactive asbestos waste for activities performed during the refurbishment period of the Overhaul Alternative is estimated to be 235 cubic meters (310 cubic yards), with the bulk of this waste being generated over a 5-year asbestos abatement period included in the refurbishment work. Because this waste would be disposed as solid LLW, it would increase the solid LLW average annual generation rate from 3550 cubic meters (see Solid LLW paragraph above) to approximately 3800 cubic meters (5000 cubic yards), which is approximately 95 percent higher than the annual NRF solid LLW generation rate. This would not result in any increase to the baseline in the annual number of shipments of solid LLW. Impacts from the generation of radioactive asbestos waste during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

RCRA Hazardous Waste

The average annual generation rate for RCRA hazardous waste during the refurbishment period of the Overhaul Alternative is estimated to be 25 cubic meters (30 cubic yards), which is approximately 300 percent higher than the annual NRF RCRA hazardous waste generation rate for combined routine and D&D work (Section 3.14.2). This would not result in any increases to the baseline in the annual number of shipments of RCRA hazardous waste. This increase in estimated RCRA hazardous waste generation would be from activities such as paint and equipment removal. The RCRA hazardous waste would continue to be sent to a commercial disposal facility. Even though the annual generation rate would exceed the annual generation rate provided in Section 3.14.2, impacts from the generation of RCRA hazardous waste during the refurbishment period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

Liquid LLW

The generation of liquid LLW (i.e., used oil) during the refurbishment period of the Overhaul Alternative would be approximately 19 liters (5 gallons) per year, so there would be no increase to the baseline annual NRF liquid LLW generation rate described in Section 3.14.4. The volume of liquid LLW generated would likely be reduced over time due to remediation efforts, such as equipment replacement or repair, associated with the Overhaul Alternative. This liquid LLW is sent off-site to be burned for fuel once it meets the treatment facility’s waste acceptance criteria. Therefore, there would be no impact from liquid LLW generation.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. Waste generated from the post-refurbishment operational period of the Overhaul Alternative would be from naval spent nuclear fuel handling and routine maintenance of ECF. MLLW and radioactive TSCA (PCB) and radioactive asbestos waste generation would not increase during the post-refurbishment operational period.

Summaries are provided below for the types and volumes of waste estimated to be generated during the post-refurbishment operational period of the Overhaul Alternative. Comparisons are also included of annual waste generation rates during the post-refurbishment operational period of the Overhaul Alternative and the NRF routine annual waste generation rates provided in Section 3.14.

Non-radioactive TSCA waste would not be generated during the post-refurbishment operational period. ECF is a radiological facility; those areas where TSCA waste is generated would likely be in a radiological area within ECF, and such waste would be managed as radioactive TSCA waste.

The annual waste generation rates for the post-refurbishment operational period of the Overhaul Alternative are conservative values, representative of projected waste generation at NRF from all activities, not just naval spent nuclear fuel handling. The annual waste generation rates for NRF that are used for comparative purposes are based on annual average waste generation rates from 2005 to 2009.

Solid LLW

Solid CH LLW and RH LLW would be generated at an average annual rate of 850 cubic meters (1100 cubic yards) during the post-refurbishment operational period of the Overhaul Alternative, which is approximately 16 percent higher than the annual average NRF solid LLW generation rate (Section 3.14.4). This would result in approximately six additional shipments of solid LLW being made per year over the baseline. The 16 percent increase in the amount of solid LLW generated is from processing naval spent nuclear fuel that arrives in M-290 shipping containers. Additional miscellaneous solid LLW (e.g., radioactive water demineralizer system modules, water pool filters, and water pool surface skimmer cleaning waste bags) would also be packaged for disposal. Even though the annual generation rate would exceed the annual generation rate provided in Section 3.14, impacts from the generation of solid LLW during the post-refurbishment operational period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

Non-Hazardous Solid Waste and Recyclable Materials

The additional 80 naval spent nuclear fuel handling workers supporting the post-refurbishment operational period of the Overhaul Alternative would generate approximately 300 cubic meters (400 cubic yards) of non-hazardous solid waste and recyclable materials annually. Conservatively assuming all this waste is non-hazardous solid waste for comparative purposes, this would equate to an approximate 4 percent increase in the average annual rate of non-hazardous solid waste generated at NRF (Section 3.14.1). This would not result in any increases to the baseline in the annual number of shipments of non-hazardous solid waste and recyclable materials. Impacts from the generation of non-hazardous solid waste and recyclable material during the post-refurbishment operational period of the Overhaul Alternative would be small, since disposal facility capacities would not be exceeded.

RCRA Hazardous Waste

The average annual generation rate for RCRA hazardous waste during the post-refurbishment operational period of the Overhaul Alternative is estimated to be 1.7 cubic meters (2.2 cubic yards), so there would be no increase to the baseline annual NRF RCRA hazardous waste generation rate for routine work. There would be no impact from the generation of RCRA hazardous waste during the post-refurbishment operational period of the Overhaul Alternative.

Liquid LLW

The generation of liquid LLW (i.e., used oil) during the post-refurbishment operational period of the Overhaul Alternative would be approximately 19 liters (5 gallons) per year, so there would be no increase to the baseline annual NRF liquid LLW generation rate described in Section 3.14.4. The volume of liquid LLW generated would likely be reduced over time due to remediation efforts, such as equipment replacement or repair, associated with the Overhaul Alternative. This liquid LLW is sent off-site to be burned for fuel once it meets the treatment facility’s waste acceptance criteria. Therefore, there would be no impact from liquid LLW generation.

4.14.3 New Facility Alternative

Construction Period

The duration of the construction activities for the New Facility Alternative would be approximately 3 years and would occur in parallel with ECF operations. During the construction period of the New Facility Alternative, wastes typical of large construction projects would be generated, specifically non-hazardous solid waste originating from excess building materials. Summaries of projected waste generation during the construction period of the New Facility Alternative are presented below. The waste generation impacts presented would be increases to the waste generation from NRF operations established in Section 3.14.

RCRA Hazardous Waste

A minimal increase in the amount of RCRA hazardous waste generated at NRF may result from unused chemicals or products (i.e., aerosols, epoxies) remaining after construction work is completed. Exact quantities are unknown at this time; however, the increased volume of RCRA hazardous waste generated is expected to be small. This would not result in any increases to the baseline in the annual number of shipments of RCRA hazardous waste. Impacts from the generation of RCRA hazardous waste during the construction period of the New Facility Alternative would be small, since disposal facility capacities would not be exceeded.

Non-Hazardous Solid Waste and Recyclable Materials

The average annual generation rate of non-hazardous solid waste and recyclable materials during the construction period at Location 3/4 or Location 6 would be approximately 10,000 cubic meters (13,000 cubic yards). The non-hazardous waste volumes include waste generation from 360 additional construction workers. The average annual generation rate represents an increase of 120 percent in non-hazardous solid waste and recyclable materials generation compared to the annual average amount generated at NRF (Section 3.14.1). This would result in negligible increases to the baseline in the annual number of shipments of non-hazardous solid waste, and no increases to the annual baseline for recyclable material shipments.

Excavation of unusable surface soil associated with the footprint of the new facility would total approximately 78,000 cubic meters (102,000 cubic yards). As described in Section 4.3.3, this material would be stockpiled near the construction site, used to backfill an existing gravel pit at NRF, or used to backfill the retired sewage lagoons. If plans change and the material is not stockpiled near the construction site or used to backfill the existing gravel pit or retired sewage lagoons, it would be disposed as non-hazardous solid waste at the INL CFA Landfill Complex. Disposal in the retired sewage lagoons would require agreement with IDEQ and EPA.

Reverse osmosis units would be used during the construction period to support water pool initial fill. The construction vendor would remove the non-hazardous solid waste generated during construction when the self-contained reverse osmosis unit trailer is removed from the NRF site. There are no chemicals required in the reverse osmosis process.

The INL CFA Landfill Complex has capacity for the increases in non-hazardous solid waste generation. Therefore, impacts associated with the non-hazardous solid waste and recyclable materials generated from the construction period of the New Facility Alternative would be small, since disposal facility capacities would not be exceeded.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. Summaries of projected annual waste generation, during the period of transition of naval spent nuclear fuel handling operations between ECF and the New Facility, are presented below. The annual waste generation rates from the transition period are compared to the routine NRF annual waste generation rates provided in Section 3.14. There would be no generation of MLLW, radioactive or non-radioactive TSCA (PCB) waste, or radioactive asbestos waste in the New Facility during the transition period. There would be no increase in the generation rates of these waste streams from continuing examinations activities in ECF during the transition period.

The annual waste generation rates for the transition period of the New Facility Alternative are conservative values, representative of projected waste generation at NRF from all activities, not just naval spent nuclear fuel handling. The annual waste generation rates for NRF that are used for comparative purposes are based on annual average waste generation rates from 2005 to 2009.

Solid LLW

Solid CH LLW and RH LLW would be generated at an average annual rate of 890 cubic meters (1200 cubic yards) during the transition period of the New Facility Alternative, which is approximately 20 percent higher than the annual NRF solid LLW generation rate for routine operations (Section 3.14.4). This would result in approximately eight additional shipments of solid LLW being made per year over the baseline. This increase would be attributed to additional waste from processing naval spent nuclear fuel that arrives in M-290 shipping containers and from the water purification system (resin and filter waste).

The solid LLW annual generation rate for the transition period of the New Facility Alternative would be higher than that described in Section 3.14; however, disposal capacity is available for this waste generation. Therefore, there would be small impacts associated with solid LLW generation for the transition period.

Non-Hazardous Solid Waste and Recyclable Materials

The additional 60 naval spent nuclear fuel handling workers supporting the transition period would generate approximately 230 cubic meters (300 cubic yards) of non-hazardous solid waste and recyclable materials annually. Conservatively assuming all this waste is non-hazardous solid waste for comparative purposes, this would equate to an approximate 3 percent increase in the average annual rate of non-hazardous solid waste generated at NRF (Section 3.14.1). This would not result in any increases to the baseline in the annual number of shipments of non-hazardous solid waste and recyclable materials. Impacts from the generation of non-hazardous solid waste and recyclable material during the transition period between the current ECF and the New Facility would be small, since disposal facility capacities would not be exceeded.

RCRA Hazardous Waste

The RCRA hazardous waste average annual generation rate for the transition period between ECF and the New Facility is estimated to be 2.5 cubic meters (3.2 cubic yards), so there would be no increase to the baseline annual NRF RCRA hazardous waste generation rate for routine work. There would be no impact from the generation of RCRA hazardous waste during the transition period of the New Facility Alternative.

Liquid LLW

During the transition period of the New Facility Alternative, generation of radioactively contaminated oil used to maintain naval spent nuclear fuel handling equipment in the new facility may occur, and would be managed as liquid LLW. Approximately 49 liters (13 gallons) of contaminated oil could be generated annually, an increase of approximately 30 liters (8 gallons) from the baseline annual NRF liquid LLW generation rate described in Section 3.14.4. This liquid LLW would be sent off-site for to be burned for fuel once it meets the treatment facility's waste acceptance criteria. Therefore, there would be no impact from liquid LLW generation.

New Facility Operational Period

The new facility operation period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF. Because the overall amount of work would remain consistent with the work that is performed during the transition period, only the non-hazardous solid waste and recyclable materials generation rate would decrease, since this waste stream is dependent upon the number of workers. There would be no generation of MLLW, radioactive or non-radioactive TSCA (PCB) waste, or radioactive asbestos waste in the New Facility during the new facility operational period. There would be no increase in the generation rates of these waste streams from continuing examinations activities in ECF during the new facility operational period.

<u>Non-Hazardous Solid Waste and Recyclable Materials</u>

Due to efficiencies gained by no longer performing parallel operations, 60 fewer naval spent nuclear fuel handling workers would be required in ECF and the New Facility (combined) for the new facility operational period. This would result in a reduction of 230 cubic meters (300 cubic yards) in the average annual generation of non-hazardous solid waste and recyclable materials at NRF. Conservatively assuming all this waste is non-hazardous solid waste for comparative purposes, this would equate to an approximate 3 percent decrease in the average annual rate of non-hazardous solid waste generated at NRF (Section 3.14.1). There would be no impact from the generation of non-hazardous solid waste and recyclable materials during the new facility operational period.

<u>Liquid LLW</u>

During the new facility operational period, generation of liquid LLW (i.e., used oil) used to maintain naval spent nuclear fuel handling equipment in the new facility may occur, and would be managed as liquid LLW. Approximately 49 liters (13 gallons) of this liquid LLW could be generated annually, an increase of approximately 30 liters (8 gallons) from the baseline annual NRF liquid LLW generation rate described in Section 3.14.4. This liquid LLW would be sent off-site to be burned for fuel once it meets the treatment facility’s waste acceptance criteria. Therefore, there would be no impact from liquid LLW generation.

4.15 Naval Spent Nuclear Fuel Management

This section discusses the potential naval spent nuclear fuel management impacts from the proposed action. Current naval spent nuclear fuel management practices are described in Section 3.15.

The handling of naval spent nuclear fuel at the end of life (i.e., the purpose and need for the proposed action) can impact the operations of the fleet and the NNPP's ability to meet the requirements of SA 1995 and SAA 2008, as described in Chapter 1. Defueling and refueling the U.S. Navy's fleet depends on, among many other factors, the efficiency of naval spent nuclear fuel handling operations. Therefore, this section describes the impact the alternatives have on the NNPP's ability to meet its mission.

As described in Section 4.2, an average of 10 shipments of naval spent nuclear fuel will be made to NRF per year over the approximate time-frame of the proposed action. This average is in accordance with SA 1995 and SAA 2008, limiting the number of shipments to 20 per year (3-year running average). In addition to M-140 shipping containers, NRF began to receive naval spent nuclear fuel in M-290 shipping containers in 2016. The NNPP would be ready to ship naval spent nuclear fuel packaged in M-290 shipping containers from NRF to an interim storage facility or geologic repository in accordance with SA 1995 and SAA 2008.

4.15.1 No Action Alternative

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment.

While ECF operations continue, the ECF infrastructure as currently configured cannot support use of the new M-290 shipping containers. Since modifications of ECF are not part of the No Action Alternative, this would result in storing naval spent nuclear fuel in M-290 shipping containers on rail lines at NRF or using a canister within the M-290 shipping container that could be removed and staged at NRF in concrete overpacks. It is anticipated that continuing operations in the current ECF would result in work stoppages, and that impacts associated with these work stoppages could affect fleet performance and the ability to manage naval spent nuclear fuel in accordance with SA 1995 and SAA 2008.

If ECF operations cease, no shipping containers would be unloaded in ECF. There are a finite number of available M-140 shipping containers. Therefore, the ability to defuel and refuel submarines would eventually cease, leading to the inability of the nuclear-powered submarines or their nuclear-trained naval personnel to be redeployed into fleet operations. The inability to transfer, prepare, and package naval spent nuclear fuel would immediately and profoundly impact the NNPP's mission and national security needs to refuel and defuel nuclear-powered submarines and aircraft carriers. In addition, the NNPP would not be able to meet the requirements of SA 1995 and SAA 2008.

Therefore, there would be large and profound impacts to naval spent nuclear fuel management and national security needs from the No Action Alternative.

4.15.2 Overhaul Alternative

The Overhaul Alternative allows for naval spent nuclear fuel to be packaged for dry storage, into a configuration that is ready to be shipped to an interim storage facility or geologic repository.

Refurbishment Period

The refurbishment period of the Overhaul Alternative would take place over 33 years in parallel with ECF operations. To continue to support receipt of shipments of naval spent nuclear fuel from shipyards and prototypes during the refurbishment period of the Overhaul Alternative, additional shipping containers could be purchased for naval spent nuclear fuel storage. Starting in the early to mid 2020s, ECF will need to accommodate the larger M-290 shipping containers. Currently, only a portion of the ECF water pool is deep enough to allow for handling aircraft carrier naval spent nuclear fuel assemblies without prior disassembly; therefore, the water pool would need to be reconfigured and additional equipment would need to be procured and installed. This would result in work stoppages which would temporarily impact the mission-critical work and delay processing of naval spent nuclear fuel into dry storage.

Management of the naval spent nuclear fuel while ECF is in the midst of refurbishment could include: purchasing additional shipping containers to stage naval spent nuclear fuel until the facility can unload it; packaging naval spent nuclear fuel into canisters at the shipyard for temporary storage at NRF in concrete overpacks; or unloading naval spent nuclear fuel from M-290 shipping containers in the CSRF to be temporarily staged in overpacks.

The impacts associated with the refurbishment period of the Overhaul Alternative would be moderate, since work stoppages would be temporary, and the facility would be operated to minimize the impact on the NNPP's ability to meet its mission.

Post-Refurbishment Operational Period

The post-refurbishment operational period addresses the 12 years after refurbishment where only operational activities would take place in ECF. Despite facility constraints, such as less than optimal product flow and continued aging of facility infrastructure, NRF would manage ECF during the post-refurbishment operational period to meet SA 1995 and SAA 2008 with the additional resources described in Section 4.10. There would be no impact from the post-refurbishment operational period of the Overhaul Alternative

4.15.3 New Facility Alternative

The New Facility Alternative allows for naval spent nuclear fuel to be packaged for dry storage, into a configuration that is ready to be shipped to an interim storage facility or geologic repository. The NNPP would manage ECF and the new facility to meet SA 1995 and SAA 2008.

Construction Period

It is anticipated that construction activities (including pre-construction activities) would occur over approximately a 5-year period. However, assessment of the majority of the impacts from construction are based on being distributed over a 3-year construction period. Due to the uncertainty regarding when the new facility might be operational, plans would be developed to manage naval spent nuclear fuel. These risk mitigation plans could include: purchasing additional M-290 shipping containers to stage naval spent nuclear fuel until the facility can unload it; packaging naval spent nuclear fuel into canisters at the shipyard for temporary storage at NRF in concrete overpacks; or unloading naval spent nuclear fuel from M-290 shipping containers in the CSRF to be temporarily staged in overpacks. The impacts to naval spent nuclear fuel management from the construction period of the New Facility Alternative would be small, due to the temporary mitigation measures necessary until the new facility is operational.

Transition Period

Operations for the New Facility Alternative would overlap with ECF operations for a period of 5 to 12 years. Operations occur in ECF to support naval spent nuclear fuel examinations and naval spent nuclear fuel handling operations. For a period of time after the new facility is built, all ECF operations would continue. Eventually, the naval spent nuclear fuel handling operations would be fully transitioned from ECF to the new facility. The impacts to naval spent nuclear fuel management from the transition period of the New Facility Alternative would be small, due to the inefficiencies of performing naval spent nuclear fuel handling operations concurrently in two separate facilities.

New Facility Operational Period

The New Facility Operational Period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF. A new facility would support all current naval spent nuclear fuel handling operations conducted at ECF. In addition, it would include the capability to unload naval spent nuclear fuel from M-290 shipping containers in the water pool and to handle aircraft carrier spent nuclear fuel assemblies without prior disassembly for preparation and packaging for disposal. There would be beneficial impacts to the management of naval spent nuclear fuel once the new facility is fully operational, due to the increased efficiencies described above.

4.16 Unavoidable Adverse Impacts

Unavoidable adverse environmental impacts are those potential impacts from implementation of an alternative that cannot be avoided and for which no practical means of mitigation are available. This section serves as a high-level summary of the adverse environmental impacts described in Chapter 4 from construction and operations activities of the proposed action that cannot be avoided. Unavoidable and adverse impacts are presented for the proposed action by resource area below as applicable. References are made to the alternatives and time periods as presented in Section 2.3.

4.16.1 Land Use

During the refurbishment period of the Overhaul Alternative, small unavoidable adverse impacts would result from ground disturbance due to construction of the new security boundary system. For the construction period of the New Facility Alternative, small unavoidable adverse impacts would result from ground disturbance from construction of the new facilities and supporting infrastructure, and land that would remain permanently developed for facilities and supporting infrastructure. The small percentage of INL land that is temporarily disturbed or permanently developed for facilities and supporting infrastructure precludes use by wildlife.

4.16.2 Transportation

For the No Action, Overhaul, and New Facility Alternatives, there would be negligible unavoidable adverse impacts from shipments of naval spent nuclear fuel since shipments are infrequent.

There would be negligible to small unavoidable adverse impacts for the Overhaul Alternative (refurbishment and post-refurbishment periods) and for the New Facility Alternative (construction and transition periods) from increased personnel transportation on U.S. Highway 20, U.S. Highway 26, and State Route 33. There would be negligible unavoidable adverse impacts during the refurbishment period of the Overhaul Alternative and small unavoidable adverse impacts during the construction period of the New Facility Alternative from increased material shipments on U.S. Highway 20, U.S. Highway 26, and State Route 33. There would be negligible unavoidable adverse impacts during the construction period of the New Facility Alternative from the transportation of non-hazardous waste, RCRA hazardous waste, and recyclable material shipments. There would be negligible unavoidable adverse impacts during the refurbishment period of the Overhaul Alternative from radiological waste shipments.

4.16.3 Geology and Soil Resources

The Overhaul Alternative (refurbishment period) would require consumption of borrow materials (e.g., sand, gravel, and constituents for concrete) for the new security boundary system construction and refurbishment activities. For the New Facility Alternative (construction period), there would be consumption of borrow materials for construction of the new facilities and supporting infrastructure. Consumption of the geologic resources would create a small unavoidable adverse impact to the resource. Small impacts to soil resources may occur, despite the use of best management practices for controlling erosion and sedimentation.

For the No Action Alternative, there could be a negligible impact from soil contamination if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak. Similarly, this impact could result during the 33-year refurbishment period of the Overhaul Alternative before all water pool refurbishments are complete.

4.16.4 Water Resources

For the No Action Alternative, there could be negligible unavoidable adverse impacts on groundwater quality and drinking water quality if preventive and corrective maintenance are not sufficient to prevent a minor water pool leak. Similarly, these impacts could result during the refurbishment period of the Overhaul Alternative before all water pool refurbishments are complete. During the New Facility Alternative transition and operational periods, there could be small unavoidable adverse impacts to water quality from an increase in the total output of non-hazardous salts in process wastewater discharge. For the New Facility Alternative (construction, transition, and operational periods) there would be small unavoidable adverse impacts to the perched water zone at the outfall to the IWD from the increased discharge. Consumption of groundwater would be a very small percentage of the Federal Reserved Water Right for the INL; and therefore, is considered a negligible unavoidable adverse impact.

4.16.5 Ecological Resources

For the Overhaul Alternative (refurbishment period) and the New Facility Alternative (construction period), there would be small unavoidable adverse impacts to vegetation and wildlife from land clearing and other construction activities. Land clearing would eliminate vegetation and wildlife habitat, and could cause wildlife injury or mortality and habitat fragmentation or avoidance. Temporary small unavoidable adverse impacts could include inadvertent establishment of non-native vegetation and noxious weeds on disturbed lands and avoidance of areas by wildlife due to increased noise. There would be a small unavoidable adverse impact to species of concern (e.g., pygmy rabbits and greater sage-grouse), similar to those for other wildlife. Habitat preferences and avoidance of roads and other human activities would make unavoidable adverse impacts small for species of concern.

For the Overhaul Alternative (refurbishment and post-refurbishment operational periods) and the transition and operational periods of the New Facility Alternative, there would be small unavoidable adverse impacts to wildlife from habitat loss and fragmentation from the new security boundary system.

4.16.6 Air Resources

During the Overhaul Alternative (refurbishment and post-refurbishment operational periods) there would be negligible unavoidable adverse impacts from an increase in criteria, toxic, and PSD air pollutant emissions at INL receptor locations.

During the New Facility Alternative (construction, transition and operational periods), there would be negligible to small unavoidable adverse impacts from an increase in criteria, toxic, and PSD air pollutant emissions at INL receptor locations. There would be negligible to small unavoidable adverse impacts from an increase in PSD pollutants at Federal Class I and Federal Class II areas. Due to the increase in emissions, there would be negligible to small unavoidable adverse impacts to visibility, ozone, and deposition. However, all air quality standards and thresholds would be met.

Impacts of global climate change on the proposed action are expected to be the same for all alternatives. Continued climate change could pose threats to infrastructure and risk to worker health and safety through increased frequency and severity of extreme weather events. There is potential for persistent drought to increase risk of power disruptions during summer months, when water shortages could lead to decreased production from the region’s electricity facilities. These potential vulnerabilities can be mitigated through existing NRF safety, operations, and emergency planning processes. The unavoidable adverse impacts from continued climate change on the proposed action would be small.

For the refurbishment period of the Overhaul Alternative, there would be negligible increases in GHG emissions primarily associated with increased commuting and increased purchased electricity. For the post-refurbishment operational period of the Overhaul Alternative, there would be negligible increases in GHG emissions primarily associated with increased commuting. For the New Facility Alternative construction period, there would be small increases in GHG emissions primarily associated with increased commuting and on-site operation of construction equipment. Diesel generators and purchased electricity would also contribute to GHG emissions. For the New Facility Alternative transition period, there would be small increases in GHG emissions primarily associated with purchased electricity and oil-fired boilers. The GHG emissions would contribute to global climate change, but unavoidable adverse impact would be negligible.

There would be negligible unavoidable adverse impacts from radiological emissions during the Overhaul Alternative post-refurbishment operational period and the new facility transition and operational periods.

4.16.7 Noise

There would be no unavoidable adverse impact from noise due to the proposed action.

4.16.8 Cultural and Historic Resources

From the New Facility Alternative (construction period), there would be small unavoidable and adverse impacts to Native American cultural resources; however, no resources eligible for listing on the National Register of Historic Places would be disturbed due to the proposed action.

4.16.9 Visual and Scenic Resources

There would be no unavoidable adverse impacts to visual and scenic resources due to the proposed action.

4.16.10 Socioeconomics

For the Overhaul Alternative and the New Facility Alternative (construction and transition periods) when there would be an increase in workforce and ROI population, there would be a small unavoidable adverse impact to public service levels because two or less additional teachers and less than one additional firefighter and police officer would be required to maintain current service levels. Under the No Action Alternative (if ECF operations cease) and during the operational period of the New Facility Alternative, there would be a small unavoidable adverse socioeconomic impact from the loss of tax revenues from a reduction in workers.

4.16.11 Energy Consumption, Site Utilities, and Security Infrastructure

There would be small unavoidable adverse impacts from an increase in energy demand from Idaho Power and energy consumption during the refurbishment period of the Overhaul Alternative and construction period of the New Facility Alternative. There would be moderate unavoidable adverse impacts from the New Facility Alternative (transition and operational periods) from an increase in energy demand from Idaho Power and energy consumption.

4.16.12 Environmental Justice

There would be no disproportionately high and adverse impacts to environmental justice populations since any potential impacts to these populations and the Shoshone-Bannock Tribes would be similar to those experienced by the general population.

4.16.13 Public and Occupational Health and Safety

When there is an increase in workers for the Overhaul Alternative (refurbishment period and post-refurbishment operational period) and New Facility Alternative (construction and transition periods), there would be a small unavoidable adverse impacts from increased occupational injuries.

During the Overhaul Alternative refurbishment and post-refurbishment operational periods and the New Facility construction, transition, and operational periods, there would be no radiological impacts to an individual worker since exposures would not change. However, there would be small unavoidable adverse impacts from a collective increase in radiological exposure to workers due to the increases in the number of workers during the Overhaul Alternative refurbishment and post-refurbishment operational periods and the New Facility transition period.

4.16.14 Waste Management

There would be small unavoidable adverse impacts from waste generation from the Overhaul Alternative (refurbishment period and post-refurbishment operational period) and New Facility Alternative (construction, transition, and operational periods). Any waste generated would be disposed of in accordance with applicable regulations.

4.16.15 Naval Spent Nuclear Fuel Management

The No Action Alternative does not provide the infrastructure necessary to support the naval nuclear reactor defueling and refueling schedules required to meet the operational needs of the U.S. Navy and the requirements of SA 1995 and SAA 2008. Therefore, there would be large unavoidable and adverse impacts to the U.S. Navy from the No Action Alternative caused by the disturbance to fleet operations and an inability to meet the requirements of SA 1995 and SAA 2008.

For the Overhaul Alternative (refurbishment period), only a portion of the ECF water pool is deep enough to allow for processing fuel from M-290 shipping containers, and the pool would need to be reconfigured and additional equipment would need to be procured and installed. This would result in work stoppages which would temporarily impact the mission-critical work performed in ECF and delay processing of naval spent nuclear fuel into dry storage; however, the facility would be operated to minimize the impact on the NNPP’s ability to meet its mission. Therefore, the moderate unavoidable adverse impacts associated with the Overhaul Alternative would be temporary.

During the construction period of the New Facility Alternative, there would be small unavoidable adverse impacts on the management of naval spent nuclear fuel from temporary mitigation measures needed until the new facility is available. During the transition period the New Facility Alternative, there would be small unavoidable adverse impacts from the inefficiencies of performing naval spent nuclear fuel handling operations concurrently in two separate facilities.

4.17 Relationship Between Short-Term Uses of the Environment and Long-Term Productivity

This section compares the potential local short-term uses of the environment for the proposed action (i.e., demands for resources and impacts to the environment as described throughout this Chapter) with the maintenance and enhancement of long-term productivity.

Implementation of any of the alternatives, including the No Action Alternative, would cause short-term impacts to the environment or commitments of resources. Further, each alternative would permanently impact the environment or commit certain resources (e.g., air or energy). Under each alternative, the short-term use of resources would result in enhancement of long-term productivity of NRF by its continued use for the NNPP mission. The long-term benefits of continuing to conduct naval spent nuclear fuel handling operations at NRF include fulfilling national defense missions and preparing naval spent nuclear fuel to be sent to an interim storage facility or placed in a geologic repository. If naval spent nuclear fuel handling no longer occurred at NRF, and the portion of the facility devoted to these activities were returned for other uses, any short-term benefit of such a transfer would be minimal compared to the long-term loss to the U.S. of a major production facility which supports the naval nuclear fleet and contributes significantly to national defense.

4.18 Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable commitments of resources that may result from the proposed action. A commitment of resources is irreversible when direct or indirect impacts limit the future options for a resource; it is a resource that cannot be restored or is destroyed. An irretrievable commitment usually applies to the use or consumption of resources that are neither renewable nor recoverable for future use by practical means. The implementation of the Overhaul Alternative or the New Facility Alternative would require the irreversible and irretrievable commitment of land, materials, energy, and water.

4.18.1 Land

For the Overhaul Alternative, additional land area would be developed for the new security boundary system. The New Facility Alternative would require land for the new security boundary system, the new facility, and supporting infrastructure (e.g., roads, rail). After D&D, this land could be restored as open space, or the buildings could be used for other purposes. Therefore, it is a conservative assumption that at least a portion of the land to be developed may result in a small irreversible commitment of a resource.

4.18.2 Materials

The irreversible and irretrievable commitment of geologic resources would result from the use of borrow resources for construction and the disposal of unusable geologic material from excavation. Most of these geologic materials would not be recycled or recovered. The Overhaul Alternative would require a smaller quantity of geologic resources for construction of the new security boundary system and refurbishment activities. The New Facility Alternative would require a larger commitment of borrow materials than the Overhaul Alternative (Section 4.3). Borrow materials are not scarce on the INL, as described in Section 3.3; however, the use of these resources would constitute a small irreversible and irretrievable commitment.

For the Overhaul Alternative or the New Facility Alternative, construction materials would be committed, including materials for electrical systems, heating, ventilation, and air conditioning (HVAC) systems, lighting, piping, steel, asphalt, concrete, glass, shelving, furniture, and other miscellaneous materials. None of these materials are scarce and could mostly be obtained from suppliers within the ROI; however, the use of these resources would constitute a small irreversible and irretrievable commitment.

4.18.3 Water

The Overhaul Alternative and the New Facility Alternative would require groundwater from the SRPA. Water resource commitments are addressed in Section 4.4. Groundwater is not considered a scarce resource; however, most of the water required would be consumed with small amounts eventually returned to the SRPA through infiltration from the IWD or infiltration basins. These groundwater withdrawals represent an irreversible and irretrievable commitment of a small amount of resource.

4.18.4 Energy

The Overhaul Alternative and the New Facility Alternative would require an increase in energy demand from Idaho Power and energy consumption. DOE has the ability under the agreement with Idaho Power to ask for additional demand above the ceiling, which may be granted at Idaho Power’s discretion, as discussed in Section 4.11. As discussed in Section 3.11, Idaho Power uses approximately 33 percent of coal to supply electric power. The increase in energy demand and energy consumption represents an irreversible and irretrievable commitment of a small amount of coal.

5.0 CUMULATIVE IMPACTS

This section addresses cumulative impacts from the proposed action. A cumulative impact is "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 C.F.R. § 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Cumulative impacts are assessed from the impacts of the alternatives described in Chapter 4 in addition to other past, present, or reasonably foreseeable future actions on the Idaho National Laboratory (INL) and surrounding region of influence (ROI), where applicable. The analysis considers other identified activities in the region that have impacts that may affect the same resources as the No Action Alternative or the proposed action. Impacts from activities may be direct or indirect, and they could be additive or interactive. Some impacts may be minor, but in combination with other effects may produce a cumulative effect that is more significant.

5.1 Methodology

The affected environment, ROI, and baseline conditions are described in Chapter 3. The impacts of the No Action Alternative and proposed action are described in Chapter 4. The impacts described in Chapter 4 are considered in addition to the past, present, and other reasonably foreseeable future actions on INL and in the ROI to identify potentially significant cumulative impacts.

The actions described in Chapter 4 could have a more significant impact on resource areas when combined with reasonably foreseeable future actions on INL. The following resource areas are evaluated due to the potential for cumulative impacts:

- Transportation
- Geology and Soils
- Water Resources
- Ecological Resources (land use also discussed)
- Air Quality
- Cultural and Historic Resources
- Socioeconomics
- Energy Consumption, Site Utilities, and Security Infrastructure
- Public and Occupational Health and Safety
- Waste Management

The following resource areas in Chapter 4 are not evaluated for cumulative impacts because the No Action Alternative and the proposed action have no impact on the resources:

- Visual and Scenic Resources
- Environmental Justice
- Noise

Cumulative impacts are analyzed for the time periods of the No Action Alternative and the proposed action described in Section 2.3, where the resources could be impacted.

Little information is available about future INL activities beyond 2021 since the primary source of this information is the INL 10-year plan (INL 2013e). In addition to the INL 10-year plan, existing National

Environmental Policy Act (NEPA) documents for proposed actions on the INL are used to develop the cumulative impacts analysis.

5.1.1 Past and Present Actions at INL

Past INL activities include: operation of fuel fabrication plants, research and test reactors, and fuel processing and research facilities; spent nuclear fuel treatment and storage; and treatment and disposal of waste. Present INL activities include: operation of research and test reactor, spent nuclear fuel processing and storage, waste treatment and disposal, site cleanup, research, and development. The result of the past and present actions is reflected in the affected environment as it is described in Chapter 3.

5.1.2 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions on INL are determined by reviewing applicable documents that list potential future actions. Table 5.1-1 provides a description of the future actions determined to be reasonably foreseeable. The United States (U.S.) Department of Energy (DOE) evaluated the construction and operation of a new facility or an existing facility for the disposal of Greater than Class C (GTCC) Low-Level Radioactive Waste (LLW) and GTCC-like waste in DOE 2011c; however, the GTCC project is not considered to have reasonably foreseeable cumulative impacts because INL is not the preferred alternative for GTCC disposal.

Table 5.1-1: Reasonably Foreseeable Future Actions on the INL

Reasonably Foreseeable Future Actions	Lead Agency	Description	Location	Project Start Date
DOE Idaho Spent Fuel Facility / Independent Spent Nuclear Fuel Storage Installation (Fuel Receiving, Canning/ Characterization, and Storage)	DOE	The proposed DOE Idaho Spent Fuel Facility would receive spent nuclear fuel from the Idaho Nuclear Technology and Engineering Center (INTEC) and the DOE-owned Fort Saint Vrain storage facility in Colorado for conditioning (e.g. drying) and packaging in a standardized canister for off-site shipment. The spent nuclear fuel would be packaged to meet interim storage, transportation, and Yucca Mountain disposal criteria. Yucca Mountain disposal criteria are a bounding assumption for packaging, but Yucca Mountain is not expected to be the geologic repository location. Limited storage to accommodate off-site transfers is included in the project. Spent nuclear fuel currently stored at INTEC is from domestic defense and commercial reactors as well as domestic and foreign research reactors. Approximately half of the material from research reactors has been received and is currently stored on-site. The first fuel types that would be processed in that facility were evaluated in an Environmental Impact Statement (EIS) in 2004 (NRC 2004).	INTEC	Unknown
The Resumption of Transient Testing of Nuclear Fuels and Materials	DOE	The Resumption of Transient Testing of Nuclear Fuels and Materials is proceeding for testing fuel behavior over a brief interval of time. This action was evaluated in a Draft Environmental Assessment (EA) issued in November 2013 (DOE 2013b); the Final EA and Finding of No Significant Impact (FONSI) were issued in February 2014 (DOE 2014a, DOE 2014e). As a result, restart activities have begun on the Transient Reactor Test Facility (TREAT) Reactor at INL, including refurbishment or replacement of systems and equipment that prepare the TREAT Reactor for restart and operations.	Materials and Fuels Complex (MFC)	2018

Table 5.1-1: Reasonably Foreseeable Future Actions on the INL (cont.)

Reasonably Foreseeable Future Actions	Lead Agency	Description	Location	Project Start Date
Establishment of Advanced Post-Irradiation Examination Capability	DOE	A multi-program, third-generation Advanced Post-Irradiation Examination Capability analytical laboratory would further consolidate and expand capabilities that function on the micro, nano, and atomic scale for highly irradiated materials. Establishment of the Advanced Post-Irradiation Examination Capability would require minor revitalization and expansion of the underlying utilities (electrical supply and data transmission) and supporting infrastructure. This action will be evaluated in an EA.	MFC	2019
New DOE Remote-Handled Low-Level Radioactive Waste (RH LLW) Disposal Facility	DOE	The replacement capability for the disposal of RH LLW generated at INL will provide disposal capability to replace existing Radioactive Waste Management Complex disposal capability and last for up to 50 years. DOE expects to generate an estimated average volume of 150 cubic meters (196 cubic yards) of RH LLW each year at INL. A Final EA and FONSI were published in December 2011. (DOE 2011a, DOE 2011b)	Southwest of Advanced Test Reactor (ATR) Complex	On-going
INL Stand-Off Experiment (SOX) Range	DOE	This range is for testing of non-intrusive active-interrogation systems capable of detecting nuclear materials in a variety of field-deployable applications at greater standoff distances. This action was evaluated in a Final EA and FONSI that were issued in March 2011. (DOE 2011f, DOE 2011g)	Northeast of Test Area North	Unknown
Recapitalization of Naval Nuclear Propulsion Program (NNPP) Examination Capabilities	NNPP	The recapitalization of the examination capabilities would provide the NNPP the ongoing capability to examine naval spent nuclear fuel, components, and irradiated test specimens. This action will be evaluated in a separate NEPA document.	Possible alternatives include the Naval Reactors Facility (NRF) or the ATR Complex. Other locations may also be evaluated.	Unknown

Table 5.1-1: Reasonably Foreseeable Future Actions on the INL (cont.)

Reasonably Foreseeable Future Actions	Lead Agency	Description	Location	Project Start Date
Plutonium-238 Production for Radioisotope Power Systems	DOE	The DOE issued the Nuclear Infrastructure Programmatic EIS in 2000 to evaluate alternatives for enhancement of DOE's nuclear infrastructure. Although a Record of Decision (ROD) was published in 2001, DOE has not implemented the decision to date. DOE still believes the decision in the 2001 ROD offers the optimum approach for production of Plutonium-238. The DOE has completed a Supplement Analysis (SA) of the Nuclear Infrastructure Programmatic EIS and issued the SA with its determination on September 16, 2013. (DOE 2013a)	ATR Complex and MFC	Unknown
Decontamination and Decommissioning (D&D) of Expended Core Facility (ECF) or new facility at NRF	NNPP	D&D of either ECF or a new facility was considered as a reasonably foreseeable future action resulting from the No Action Alternative or the proposed action. The timing of future D&D activities is not known at this time. Detailed impacts from D&D would be assessed at the end of all ECF operations or the new facility operations but prior to the start of any D&D activities. When the D&D plan is developed, it would require a separate NEPA document. D&D activities are beyond the planning basis for this EIS.	NRF	Unknown
D&D of Buildings Ancillary to the Naval Prototype Plants at NRF	NNPP	The NNPP issued an EA for the demolition of fourteen buildings and one structure ancillary to the naval prototype plants at NRF in April 2000. The EA evaluates the environmental impacts from the D&D of 14 buildings and one structure at NRF. D&D has been completed for approximately half of the buildings and the one structure. The completion of the D&D for the remaining buildings ancillary to the naval prototype plants at NRF is considered a reasonably foreseeable future action.	NRF	On-going
Utah Municipal Power Systems Small Modular Reactors	NRC	This speculative project would site up to 12 small nuclear reactors, rated at 50 megawatts each, on the INL site. DOE and an energy cooperative with members in eight states are negotiating a plan for the project. These reactors would be used to generate electricity and would replace aging coal-fired power plants.	INL	Unknown

Table 5.1-1: Reasonably Foreseeable Future Actions on the INL (cont.)

Reasonably Foreseeable Future Actions	Lead Agency	Description	Location	Project Start Date
Sample Preparation Laboratory	DOE	This is a proposed project that would include a shielded cell(s) to support sample preparation of non-alpha bearing materials with the ability to receive small and medium-sized casks, as well as sort, size, polish, mount, and conduct initial analysis of materials specimens.	INL	Unknown

Although several projects in Table 5.1-1 are deemed reasonably foreseeable in this EIS, the details of those projects are too speculative to allow for meaningful consideration. Therefore, there can be no analysis of the cumulative impacts for those projects. Cumulative impact analysis was completed for a subset of the actions in Table 5.1-1. These actions are:

- DOE Idaho Spent Fuel Facility/Independent Spent Nuclear Fuel Storage Installation (Fuel Receiving, Canning/Characterization, and Shipping) (NRC 2004)
- New DOE RH LLW Disposal facility (DOE 2011a)
- INL SOX Range (DOE 2011f)
- The Resumption of Transient Testing of Nuclear Fuels and Materials (DOE 2013b)
- Plutonium-238 Production for Radioisotope Power Systems (DOE 2013a)
- D&D of Buildings Ancillary to the Naval Prototype Plants at NRF (NNPP 2000)

Actions off of INL, but within the ROI, are also considered for cumulative impacts. The only project in the ROI that would impact similar resources is:

- AREVA Enrichment Services Eagle Rock Enrichment Facility (NRC 2011)

AREVA Enrichment Services submitted an application to the Nuclear Regulatory Commission for a license to construct, operate, and decommission the proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho. If licensed, the proposed facility would enrich uranium for use in commercial nuclear fuel for power reactors. This project was evaluated in an EIS issued in February 2011. The time-frame for the construction and operation of this facility is currently unknown. The Eagle Rock Enrichment Facility is considered in all resource evaluations where NRC 2011 identified impacts in the ROIs for this EIS.

5.2 Resource Area Evaluations

5.2.1 Transportation

The ROI for cumulative impacts to transportation includes the INL on-site road systems, two U.S. highways, and a state route (Figure 3.2-1). NRC 2011 is evaluated for cumulative impacts to transportation since it identifies impacts to the transportation ROI in this EIS.

The proposed action would have a maximum of a 3 percent increase of traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 during the 33-year refurbishment period for the Overhaul Alternative and a 6 percent increase of traffic on U.S. Highway 20, U.S. Highway 26, and State Route 33 during the 3-year construction period of the New Facility Alternative. Impacts to transportation from the proposed action would be small. Transportation impacts for the Resumption of Transient Testing of Nuclear Fuels and Materials would be negligible from 34 material shipments per year. Impacts to transportation are not analyzed in other NEPA documents for the other reasonably foreseeable future actions on the INL. In addition, the time-frame of several of the actions is also unknown.

The infrastructure for traffic on the INL is sufficient for existing conditions with margin. Therefore, the impacts of the proposed action in combination with the other reasonably foreseeable future actions on INL would not cause a cumulative impact to transportation.

Impacts to transportation from the proposed Eagle Rock Enrichment Facility are estimated to be an increase in daily local traffic on U.S. Highway 20 of 35 percent (NRC 2011). As discussed in NRC 2011, the relationship between the current and anticipated traffic volume on U.S. Highway 20 (in the vicinity of the proposed Eagle Rock Enrichment Facility site) and the road's design capacity is unknown, because the road was established before it became a major commuter route to INL. The Idaho Transportation Department notes that the road is not designed for a specific level of service and is not engineered to accommodate the current traffic flow. However, the level of service is considered high for a two-lane road. NRC 2011 concluded that based on average traffic volumes, average traffic speeds, and the highly directional nature of peak flow (largely consisting of INL commuters); the Level of Service (LOS) on U.S. Highway 20 is estimated to be high density but stable flow during peak periods and free flow at all other times. The impacts described in NRC 2011 are expected to be similar in combination with the proposed action. This associated level of increased traffic would have a small to moderate cumulative impact on the current traffic on U.S. Highway 20.

5.2.2 Geology and Soils

The ROI for cumulative impacts to geology and soils includes the INL and NRF. The Eagle Rock Enrichment Facility is not evaluated for cumulative impacts to geology and soil resources because NRC 2011 does not identify any geology and soil impacts to the ROI defined in this EIS for geologic and soil resources. Table 3.3-1 provides the availability of borrow sources on INL. The impacts described in Section 4.3 would have a small impact on the volume of material available for future use on INL. Although specific information was not available about the other reasonably foreseeable future actions described in Table 5.1-1, they would have a small impact on the availability of borrow sources for future actions. There would be no cumulative impact to geology and soils from the reasonably foreseeable future actions in combination with the proposed action.

5.2.3 Water Resources

The ROI for cumulative impacts to water resources includes INL and NRF surface waters where storm water, industrial wastewater, or sanitary wastewater are discharged (e.g., Industrial Waste Ditch and active sewage lagoons), perched water zones and groundwater beneath NRF, and the Snake River Plain Aquifer (SRPA) beneath and downstream of INL. The Eagle Rock Enrichment Facility is included in water resources cumulative impact analysis because NRC 2011 identifies impacts in the ROI defined in this EIS for water resources. Section 4.4 assesses the impact on water resources for water quality and water use. These are addressed separately below.

Water Quality

A potential cumulative impact related to past and present actions is the contaminated groundwater underlying INL facilities. As described in Section 3.4.2.2, localized areas of radiochemical and chemical contamination are present in the SRPA beneath INL. These areas, or plumes, are considered to be the results of past disposal practices. Of principal concern at INL over the years have been the movements of the tritium (^{3}H) and strontium-90 (^{90}Sr) plumes. Iodine-129 (^{129}I) has also been a concern. Groundwater monitoring has generally shown long-term trends of decreasing concentrations for these radionuclides, and current concentrations are near or below U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water (Figures 3.4-12, 3.4-13). The decreases in concentrations are attributed to discontinued disposal to the aquifer and radioactive decay within the aquifer.

Past and present operations at NRF have had no significant impact on groundwater quality. As described in Section 4.4, the No Action Alternative and the proposed action would have a small impact on water quality. The predicted concentrations would be lower than the maximum contaminant levels and would still meet groundwater standards. For the new DOE RH LLW Disposal Facility, the potential exists for contaminants to be released to the SRPA. The predicted concentrations would be lower than the maximum contaminant levels and would still meet groundwater standards. Specific information regarding water quality was either not available or there was no measurable impact for the other reasonably foreseeable future actions. Contaminants from operation of the Eagle Rock Enrichment Facility would likely be absorbed by overlying soils before reaching the aquifer (NRC 2011). The potential groundwater plumes for INL and the site for the Eagle Rock Enrichment Facility interact downstream of INL; however, the impacts from the reasonably foreseeable future actions in combination with the No Action Alternative or proposed action would have no cumulative impact to the water quality of the SRPA.

Water Use

Past and present INL operations use groundwater as the water supply source. The Federal Reserved Water Right for INL allows a maximum water consumption of 43 billion liters (11.4 billion gallons) per year from the SRPA. Annual INL water withdrawals from the SRPA in 2009 totaled approximately 3.6 billion liters (950 million gallons) of water, which is approximately 8 percent of the Federal Reserved Water Right for INL. Table 5.2-1 provides the water withdrawals expected from the proposed action and other reasonably foreseeable future actions on the INL. The New DOE RH LLW Disposal facility, INL SOX Range, D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, and the Plutonium-238 Production for Radioisotope Power Systems project did not quantify groundwater withdrawal. For the proposed action, 13.6 million liters (3.6 million gallons) per year would be attributed to the annual water withdrawals from the SRPA. This would be an increase of approximately 0.4 percent of the INL total withdrawal and approximately 0.03 percent of the Federal Reserved Water Right for INL.

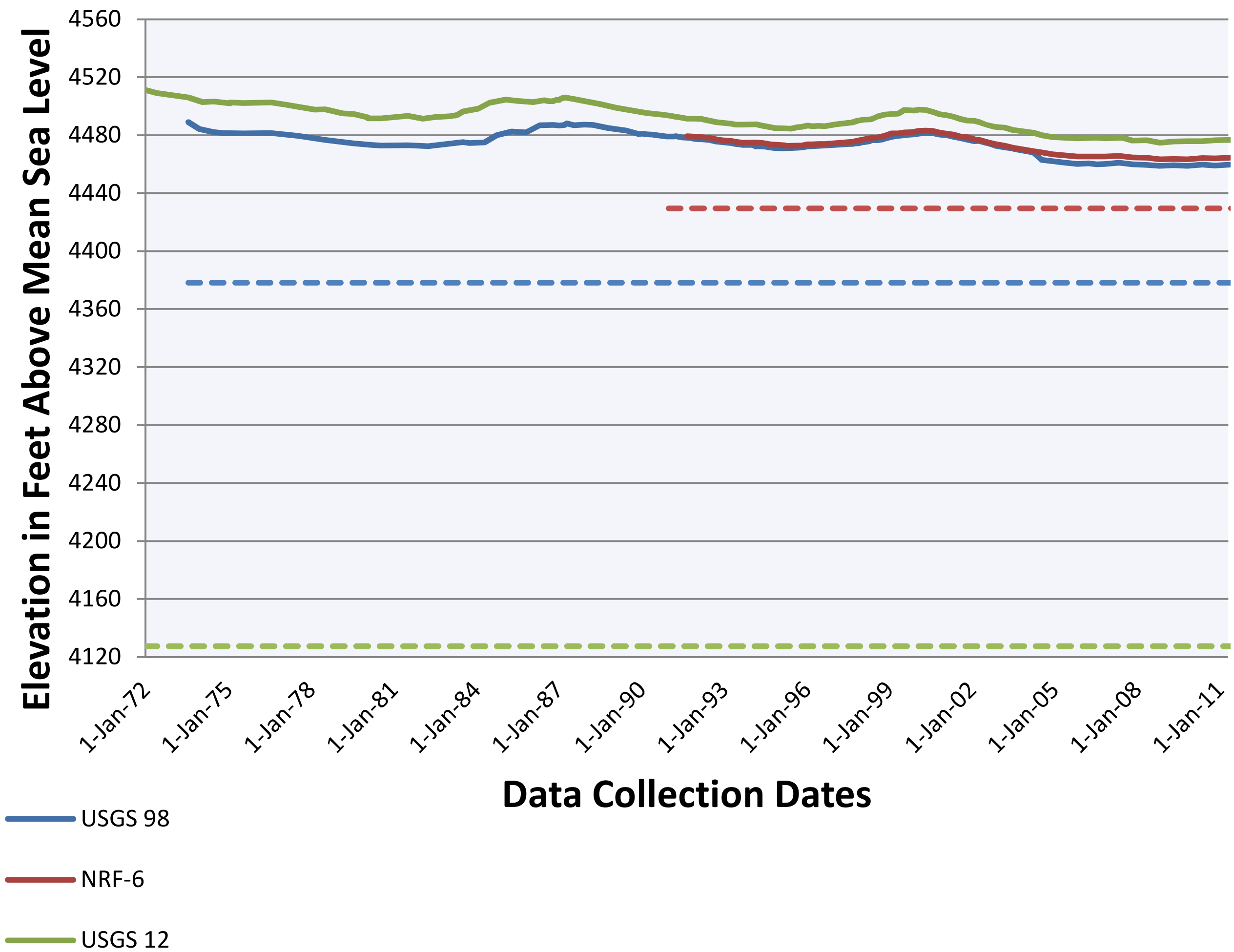
Table 5.2-1: Water Withdrawals for the Proposed Action and Reasonably Foreseeable Future Actions

Action		Groundwater Withdrawal	
		liters per year	gallons per year
DOE Idaho Spent Fuel Facility		1.7 million	0.4 million
New DOE RH LLW Disposal facility		Not analyzed	
INL SOX Range		Not analyzed	
Resumption of Transient Testing of Nuclear Fuels and Materials		Not analyzed	
D&D of Buildings Ancillary to the Naval Prototype Plants at NRF		Not analyzed	
Plutonium-238 Production for Radioisotope Power Systems project		Not analyzed	
Proposed Action[1]	Overhaul Alternative (Refurbishment Period)	8.5 million	2.2 million
	New Facility Alternative (Transition Period)	13.6 million	3.6 million
Total Increase for INL		15.3 million	4.0 million
Eagle Rock Enrichment Facility		98.4 million	26 million
Total for ROI		114 million	30 million

[1] New Facility Alternative impacts contribute to totals since the impact is bounding for the alternatives.

Based on the information available, the cumulative impacts for all of the actions on INL in Table 5.2-1 (including the proposed action) would be an increase of approximately 3.2 percent in the annual groundwater withdrawals from the SRPA. These withdrawals would have a negligible cumulative impact since they do not approach the Federal Reserved Water Right for INL (even including the Eagle Rock Enrichment Facility, which would not have access to the Federal Reserved Water Right for INL).

However, these withdrawals, including those from the Eagle Rock Enrichment Facility, would contribute to the declining SRPA water table elevation and could eventually impact water availability to other INL facilities or to downstream users. For the past several decades, the water table has been declining due to water use and periodic drought years (BMPC 2012). This has resulted in decreasing water levels in wells at NRF. Figure 5.2-1 shows hydrographs for wells U.S. Geological Survey (USGS) 12 (upgradient to NRF), USGS 98 (downgradient to NRF), and NRF-6.



Notes: The dotted lines in Figure 5.2-1 show the elevation of the bottom of each well.
1 foot = 0.305 meter

Figure 5.2-1: Trend of Water Table Elevations in NRF Wells

These wells are typical of the aquifer conditions near NRF but are likely representative of other conditions within the SRPA. This graph shows both cyclical and long-term trends in water table elevation. The graphs exemplify a variable pattern of decline in water table elevation, with each decrease corresponding to a drought event. In USGS 12, the water level has declined approximately 6 meters (18 feet) since 1980 (trough to trough on the graph). The water level in NRF-6 has declined almost 3 meters (9 feet) since 1995. If decline continues for the next 100 years, it is predicted that these wells (and others) would go dry. After the wells hit the completion depth they would need to be deepened to reach the aquifer.

5.2.4 Ecological Resources

The ROI for cumulative impacts to ecological resources includes NRF, the surrounding INL land area, and vegetation and wildlife in Federal Class I areas (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park) that could be impacted by air pollutants. The Eagle Rock Enrichment Facility is not evaluated for cumulative impacts to ecological resources because NRC 2011 does not identify any impacts to the ROI identified in this EIS for ecological resources. The D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, the Resumption of Transient Testing of Nuclear Fuels and Materials, and the Plutonium-238 Production for Radioisotope Power Systems project are not evaluated for cumulative impacts to ecological resources because no new construction would occur that could cause direct disturbance to ecological resources.

Much of the INL land is undeveloped sagebrush steppe which supports a rich diversity of native plant and animal species. Additionally, some of the area is suitable habitat for sagebrush-obligate species such as the greater sage-grouse and pygmy rabbit. Cumulative impacts to ecological resources caused by future actions would be proportional to additional disturbances that result in vegetation and habitat loss. Cumulative habitat loss based on current and future actions is provided in Table 5.2-2.

Table 5.2-2: Ecological Resource Impacts for the Proposed Action and Reasonably Foreseeable Future Actions

<table>
<tr><th colspan="2" rowspan="2">Action</th><th colspan="2">Land Disturbance</th><th rowspan="2">Habitat Impact</th></tr>
<tr><th>acres</th><th>hectares</th></tr>
<tr><td colspan="2">DOE Idaho Spent Fuel Facility</td><td>18</td><td>7</td><td>Very minor habitat loss</td></tr>
<tr><td colspan="2">New DOE RH LLW Disposal Facility</td><td>50</td><td>20</td><td>No habitat or sign of sage-grouse or pygmy rabbit were found</td></tr>
<tr><td colspan="2">INL SOX Range</td><td>3300</td><td>1336</td><td>Poor quality vegetation and limited greater sage-grouse and pygmy rabbit habitat. Very little of the land disturbed is for infrastructure. Most of the area is buffer zone with no soil disturbance.</td></tr>
<tr><td colspan="2">Resumption of Transient Testing of Nuclear Fuels and Materials</td><td colspan="3">Not analyzed</td></tr>
<tr><td colspan="2">D&D of Buildings Ancillary to the Naval Prototype Plants at NRF</td><td colspan="3">Not analyzed</td></tr>
<tr><td colspan="2">Plutonium-238 Production for Radioisotope Power Systems Project</td><td colspan="3">Not analyzed</td></tr>
<tr><td rowspan="2">Proposed Action[1]</td><td>Overhaul Alternative (Refurbishment Period)</td><td>50</td><td>20</td><td>Very minor habitat loss</td></tr>
<tr><td>New Facility Alternative (Construction Period)</td><td>150</td><td>60</td><td>Minor habitat loss</td></tr>
<tr><td colspan="2">Total for All Actions</td><td>3518</td><td>1423</td><td></td></tr>
<tr><td colspan="5">[1] New Facility Alternative impacts contribute to total since the impact is bounding for the alternatives.</td></tr>
</table>

For the proposed action, there would be minor habitat loss because a maximum of 60 hectares (150 acres) of land disturbance would occur. Approximately 226,000 hectares (558,600 acres) of the 230,700 hectares (570,000 total acres) at the INL are undisturbed; the proposed action would affect 0.01 percent of the undisturbed INL land. The 60 hectares (150 acres) of land disturbance combined with land disturbance of the reasonably foreseeable future actions totals 1423 hectares (3518 acres). These reasonably foreseeable future actions would cumulatively affect less than 0.6 percent of the undisturbed INL land and increase the disturbed land area total from 2 percent to approximately 2.6 percent; therefore, the ecological diversity at INL should be maintained and minimal habitat loss would occur. Compliance with the requirements of the Endangered Species Act and related federal and state laws would apply to the future actions.

When the proposed action is modeled cumulatively with emissions from other INL facilities (including the rest of NRF) all pollutant standards would be met as indicated by ratios of increment consumption to the standards that are much less than 1.0. Therefore, there would be no cumulative impact to vegetation and wildlife in Federal Class I areas from Prevention of Significant Deterioration (PSD) air pollutant emissions.

5.2.5 Air Quality

As described in Section 3.6.2, the current radiological and non-radiological air quality at INL is in compliance with applicable federal and state standards. Non-radiological air quality (including impact to visual and scenic resources) and radiological air quality are discussed separately below.

Non-Radiological Air Quality

The ROI for cumulative impacts from non-radiological air quality includes public roads and receptors and Federal Class I areas that could be impacted by INL emissions (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park). The Eagle Rock Enrichment Facility is included for cumulative impacts to non-radiological air quality because NRC 2011 identified impacts in the ROI defined in this EIS for non-radiological air quality.

As described in Section 4.6.1, atmospheric dispersion modeling is performed for the proposed action to estimate:

- Criteria, toxic, and hazardous air pollutant concentrations for ambient air (at locations of public access)
- PSD air pollutant concentrations for ambient air
- Visibility and PSD air pollutant impacts on Federal Class I areas

There would be small impacts from an increase in pollutant emissions for the proposed action; however, all air quality standards would be met for criteria, toxic, and PSD air pollutants at INL receptor locations. PSD and visibility standards would also be met for Federal Class I areas for the proposed action (Section 4.6.1).

For the new DOE RH LLW Disposal facility, there would be a negligible increase in toxic and criteria air pollutants. The D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, the Resumption of Transient Testing of Nuclear Fuels and Materials, and the INL SOX Range NEPA documents do not analyze toxic and criteria air pollutants.

For the DOE Idaho Spent Fuel Facility, construction-related fugitive dusts and exhaust emissions would be temporary and highly localized. By watering during construction of the DOE Idaho Spent Fuel Facility, the impacts of fugitive dust and particulates would be about 8200 kilograms (9 tons); this is small in relation to the total INL emissions of particulates. During operation of the DOE Idaho Spent Fuel Facility, there would be no chemical air discharges, and the vehicular exhausts would be small.

Small additional emissions from the DOE Idaho Spent Fuel Facility and the proposed action and negligible increases from the new DOE RH LLW Disposal facility, the D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, the Resumption of Transient Testing of Nuclear Fuels and Materials, and the Plutonium-238 Production for Radioisotope Power Systems project, would not jeopardize the ability to meet the applicable standards. After mitigation measures are put in place for the Eagle Rock Enrichment Facility, air impacts would remain at acceptable levels and would not jeopardize the ability to meet the applicable standards. Therefore, there would be no cumulative impact on non-radiological air quality from the reasonably foreseeable future actions in combination with the proposed action.

Cumulative impacts from greenhouse gases (GHG) from INL current and future operations, Eagle Rock Enrichment Facility, and the proposed action were evaluated. Cumulative GHG emissions from reasonably foreseeable future actions on the INL and from the proposed action would be less than 25,000 metric tons per year of carbon dioxide equivalent (MT CO_2e). The Eagle Rock Enrichment Facility would also increase GHG emissions for the ROI but the increase would be small. Most of the increase would be due to Scope 2 GHGs (purchased electricity). Based on the total increase of GHG emissions from the reasonably foreseeable future actions, the proposed action, and current INL operations, cumulative impacts on climate change would be small.

Impacts to operations from global climate change are evaluated. Global climate change is described in Section 3.6.2.2. Continued climate change could pose threats to infrastructure and risk to worker health and safety through increased frequency and severity of wildfires. Persistent drought may increase the risk of power disruptions during summer months when water shortages could lead to decreased energy production from the region's electricity facilities. Increased temperatures resulting in additional cooling demands in the summer may also contribute to power disruption. These potential vulnerabilities can be mitigated through existing INL and NRF safety, operations, and infrastructure planning processes. Therefore, cumulative impacts of climate change from the reasonably foreseeable future actions, the proposed action, and current INL operations would be small.

Radiological Air Quality

The ROI for cumulative impacts from radiological air quality includes the 80.5-kilometer (50-mile) radius of NRF. Section 4.6.2 describes an increase in radiological air emissions from NRF due to the proposed action of approximately 2 Curies per year. However, NRF's contribution to overall INL emissions will remain at approximately 0.03 percent. A review of the reasonably foreseeable future actions to include the Eagle Rock Enrichment Facility, the new DOE RH LLW Disposal facility, the Resumption of Transient Testing of Nuclear Fuels and Materials, and the INL SOX Range, show that there would be insignificant amounts of gaseous radionuclide emissions. The Plutonium-238 Production for Radioisotope Power Systems project and the D&D of Buildings Ancillary to the Naval Prototype Plants at NRF are not evaluated for cumulative impacts of gaseous radionuclide emissions. The Eagle Rock Enrichment Facility is included in radiological air quality cumulative impacts analysis because NRC 2011 identifies impacts in the ROI defined in this EIS for radiological air quality. For the DOE Idaho Spent Fuel Facility, initial spent nuclear fuel handling and repackaging operations could result in the release of small amounts of radioactive gases; however, after the initial receipt and repackaging of spent nuclear fuel, there would be minimal generation of gaseous radioactive waste. Therefore, none of the reasonably foreseeable future actions in combination with the proposed action would create a cumulative impact to radiological air quality.

5.2.6 Cultural and Historic Resources

The ROI for cumulative impacts to cultural and historic resources is NRF. The Eagle Rock Enrichment Facility, DOE Idaho Spent Fuel Facility, the New DOE RH LLW Disposal facility, the Plutonim-238 Production for Radioisotope Power Systems project, the Resumption of Transient Testing of Nuclear Fuels and Materials, and the INL SOX Range are not evaluated for cumulative impacts to cultural resources and historic properties because these reasonably foreseeable future actions are not at NRF. As described in Section 4.8, there would be no adverse effect to historic properties eligible for listing on the National Register of Historic Places (NRHP); however, there would be small unavoidable impacts to Native American cultural resources under the New Facility Alternative. For the D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, the Idaho State Historic Preservation Office (SHPO) indicated that some of the properties planned for D&D might be eligible for the NRHP. To mitigate any adverse effects of D&D on the historical aspects of these buildings and structure, NNPP and the Idaho SHPO agreed upon specific documentation, including photographs and narratives, in a Memorandum of Agreement (NNPP 2000). There would be negligible cumulative impacts to cultural and historic resources from the proposed action and the reasonably foreseeable future actions.

5.2.7 Socioeconomics

The ROI for cumulative impacts to socioeconomics includes the seven-county ROI associated with INL: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison counties. As described in Section 4.10, there would be some small socioeconomic impacts from the No Action Alternative and the proposed action. For the Plutonium-238 Production for Radioisotope Power Systems project, no new employment is anticipated. For the D&D of Buildings Ancillary to the Naval Prototype Plants at NRF, the number of additional jobs created for D&D would be so small that there would be no discernible impact on local services, infrastructure, or economics. For the Eagle Rock Enrichment Facility, because of the small number of workers expected during construction and operations, the socioeconomic impact would be small (NRC 2011). Detailed information about socioeconomic impacts is not available for the other reasonably foreseeable future actions on INL. In addition, the time-frame of several of the actions is unknown. However, in general, the socioeconomic outlook is positive based on the reasonably foreseeable future actions. There would be negligible cumulative impacts on the population, community services, and tax revenues from the No Action Alternative or the proposed action and these reasonably foreseeable future actions.

5.2.8 Energy Consumption, Site Utilities, and Security Infrastructure

The ROI for cumulative impacts to energy consumption, site utilities, and security infrastructure is the INL and NRF. The Eagle Rock Enrichment Facility is not evaluated for cumulative impacts to energy consumption, site utilities, and security infrastructure because NRC 2011 does not identify any impacts to the ROI identified in this EIS for energy consumption, site utilities, and security infrastructure. As described in Section 4.11, the operation of the new facility in parallel with the operation of ECF (transition period and new facility operational period of the New Facility Alternative) would create a moderate impact to the electrical infrastructure at the INL because the current contract demand in the agreement with Idaho Power of 45 megawatts would be close to being exceeded. However, the maximum contract demand has a ceiling of 55 megawatts; and DOE has the ability under the agreement with Idaho Power to ask for additional demand above the 55 megawatt ceiling, which may be granted at Idaho Power's discretion. INL prepares an annual load forecast for Idaho Power every year accounting for current activities and reasonably foreseeable future actions. Based on the expected needs of all INL facilities and the reasonably foreseeable future actions on the INL, INL could exceed the contract demand ceiling of 55 megawatts by 2022. Minor modifications to the INL electrical infrastructure (e.g., additional capacitor banks) could be necessary to meet electrical demands at these cumulative levels.

5.2.9 Public and Occupational Health and Safety

This discussion focuses on the impacts to public health and safety from radiological emissions. The ROI for cumulative impacts of non-radiological health and safety impacts is NRF; therefore, there would be no cumulative impact to non-radiological health and safety from other reasonably foreseeable future actions. This section will describe the cumulative impact to the maximally exposed off-site individual (MOI) and the population within the 80.5-kilometer (50-mile) radius of INL (i.e., the

ROI) from operational releases. The Eagle Rock Enrichment Facility is included in cumulative impacts analysis for public health and safety from radiological emissions because NRC 2011 identifies impacts in the ROI defined in this EIS for public health and safety from radiological emissions.

In this EIS, the health impacts from radiation exposure are characterized with dose and risk of developing fatal cancer as discussed in Section 4.13.2.

MOI

Table 3.13-3 shows that the average annual dose received by the maximally exposed off-site public individual (MEI) for INL operations is 9.8×10^{-7} Sievert (9.8×10^{-5} rem). Table 5.2-3 presents the impacts to the MOI from the proposed action, present INL operations, and reasonably foreseeable future actions on INL. The impacts to the MOI are conservative because the MOI for each action is not located at the same spot.

Table 5.2-3: Impacts to the Maximally Exposed Off-Site Individual for the Proposed Action and Reasonably Foreseeable Future Actions

Action		Dose	
		Sievert per year	rem per year
DOE Idaho Spent Fuel Facility		6.3×10^{-10}	6.3×10^{-8}
New DOE RH LLW Disposal Facility		8.8×10^{-6}	8.8×10^{-4}
INL SOX Range		2.1×10^{-7}	2.1×10^{-5}
Resumption of Transient Testing of Nuclear Fuels and Materials		1.1×10^{-8}	1.1×10^{-6}
D&D of Buildings Ancillary to the Naval Prototype Plants at NRF		Not analyzed	
Plutonium-238 Production for Radioisotope Power Systems		2.6×10^{-15}	2.6×10^{-13}
Proposed Action[1]	Overhaul Alternative (Post-Refurbishment Period)	6.0×10^{-9}	6.0×10^{-7}
	New Facility Alternative (Transition and New Facility Operational Period)	6.0×10^{-9}	6.0×10^{-7}
Present INL Operations[2]		9.8×10^{-7}	9.8×10^{-5}
Total for INL		1.0×10^{-5}	1.0×10^{-3}
Eagle Rock Enrichment Facility		1.4×10^{-5}	1.4×10^{-3}
Total for ROI		2.4×10^{-5}	2.4×10^{-3}

[1] New Facility Alternative impacts contribute to the Total for INL since the impact is bounding for the alternatives under the proposed action.
[2] Average annual dose received by the MEI for INL operations (Table 3.13-3).

For all present actions and reasonably foreseeable future actions on INL and the proposed action, the total dose to the MOI from Table 5.2-3 is approximately 0.01 milliSievert (1.0 millirem). The total dose to the MOI increases to 0.024 milliSievert (2.4 millirem) accounting for the Eagle Rock Enrichment Facility. The EPA annual dose limit is 10 millirem per year (40 C.F.R. § 61.102), and the natural background annual radiation is 3.1 milliSievert (310 millirem) in this general area. Therefore, cumulative radiation impacts to the MOI from routine naval spent nuclear fuel handling operations of the proposed action and reasonably foreseeable future actions would be small.

Population

Table 3.13-4 shows that the impact from the past and present INL operations results in an average population dose of 5.4×10^{-3} person-Sievert (5.4×10^{-1} person-rem) and an annual risk of developing fatal cancer of 3.0 x 10^{-4} in the population. Table 5.2-4 presents the impacts to the population from the proposed action, present INL operations, and reasonably foreseeable future actions on INL.

As described in Section 4.6.2, radiological emissions from routine naval spent nuclear fuel handling operations are expected to increase under the proposed action. These radiological emissions result in a population dose of 2.0 x 10^{-4} person-Sievert (2.0 x 10^{-2} person-rem) and an annual risk of developing fatal cancer of 1.1 x 10^{-5} in the population (Section 4.13.2.1). This represents an increase in radiological exposure for the public from the 2009 ECF exposures presented in Table 3.13-6.

Table 5.2-4: Impacts to the Population for the Proposed Action and Reasonably Foreseeable Future Actions

Action		Annual Population Dose		Fatal Cancer
		person-Sievert	person-rem	
DOE Idaho Spent Fuel Facility		Not analyzed		
New DOE RH LLW Disposal Facility		Not analyzed		
INL SOX Range		Not analyzed		
Resumption of Transient Testing of Nuclear Fuels and Materials		Not analyzed		
D&D of Buildings Ancillary to the Naval Prototype Plants at NRF		0	0	0
Plutonium-238 Production for Radioisotope Power Systems		6.3 x 10^{-8}	6.3 x 10^{-6}	1.3 x 10^{-7}
Proposed Action[1]	Overhaul Alternative (Post-Refurbishment Period)	2.0 x 10^{-4}	2.0 x 10^{-2}	1.1 x 10^{-5}
	New Facility Alternative (Transition and New Facility Operational Period)	2.0 x 10^{-4}	2.0 x 10^{-2}	1.1 x 10^{-5}
Present INL Operations[2]		5.4 x 10^{-3}	5.4 x 10^{-1}	3.0 x 10^{-4}
Total for INL		5.6 x 10^{-3}	5.6 x 10^{-1}	3.1 x 10^{-4}
Eagle Rock Enrichment Facility		1.7 x 10^{-5}	1.7 x 10^{-3}	9.4 x 10^{-7}
Total for ROI		5.6 x 10^{-3}	5.6 x 10^{-1}	3.1 x 10^{-4}

[1] New Facility Alternative impacts contribute to the Total for INL since the impact is bounding for the alternatives under the proposed action.
[2] Average annual exposure to the general population and fatal cancer from INL operations (Table 3.13-4).

The cumulative impact in the ROI for population dose is an increase in exposure of approximately 5.6 x 10^{-3} person-Sievert (5.6 x 10^{-1} person-rem) or approximately 4 percent. This results in an annual increase in risk of developing fatal cancer of 3.1 x 10^{-4} in the population. The increase in radiation exposure from routine naval spent nuclear fuel handling operations and reasonably foreseeable future actions would be negligible compared to annual radiation exposure. Therefore, there would be a negligible cumulative impact to the public from radiological exposures.

5.2.10 Waste Management

The ROI for waste management is the INL and NRF. The Eagle Rock Enrichment Facility is not evaluated for cumulative impacts to waste management because NRC 2011 does not identify any waste management impacts to the ROI defined in this EIS for waste management.

Contact-handled LLW, mixed LLW, radioactive Toxic Substances Control Act waste, and Resource Conservation and Recovery Act hazardous waste are not analyzed under cumulative impacts because these wastes are disposed of at commercial waste disposal facilities that are not on INL. It is reasonably assumed that if one of the commercial disposal facilities currently used reaches capacity, NRF would establish a contract with a different existing facility, or a new commercial facility would be available as a replacement.

For non-hazardous waste, there would be no cumulative impact for the proposed action and the reasonably foreseeable future actions because the capacity of the INL Central Facilities Area landfill would not be exceeded. As described in Section 4.14, the impact for solid LLW generation is judged relative to whether there is sufficient disposal capacity for the waste. In the development of the new DOE RH LLW Disposal facility, DOE plans to provide dependable and predictable disposal capacity in support of continued INL site operations (DOE 2011a). There would be no cumulative impact from the generation of RH LLW from the proposed action and reasonably foreseeable future actions since disposal facility capabilities would not be exceeded.

5.2.11 Decontamination and Decommissioning

Eventually, any facility used for spent fuel handling operations would be subject to the process of D&D. Depending upon the decisions made as a result of this EIS, D&D could be required for ECF or the ECF and the new facility. The primary D&D goal would be to decontaminate any facility to the extent that its residual radioactivity would be at an acceptable level. The facility decontamination would be conducted in accordance with all applicable regulations and requirements and in a manner which would minimize potential impacts to the health and safety of workers, the general public, and the environment.

Under the New Facility Alternative, a new facility would be built to support all current naval spent nuclear fuel handling operations conducted at ECF. At the end of life for this facility, it would undergo D&D. The new facility would be designed to account for the eventual D&D of the new facility, with the intent to reduce radioactive and hazardous wastes.

5.3 Summary

In general, the proposed action in combination with all past, present, and reasonably foreseeable future actions would continue to have a small impact on INL and surrounding environments. Of all the resources evaluated in detail, energy consumption is the largest cumulative impact identified. Based on the expected needs of all INL facilities, INL could exceed the contract demand ceiling of 55 megawatts by 2022. DOE has the ability under the agreement with Idaho Power to ask for additional demand above the 55 megawatt ceiling, which may be granted at Idaho Power's discretion; however, minor modifications to the INL electrical infrastructure (e.g., additional capacitor banks) may be necessary to meet electrical demands at these levels.

6.0 POTENTIAL MITIGATION MEASURES

This section addresses potential mitigation measures for the proposed action. The Council on Environmental Quality (40 C.F.R. § 1508.20) defines mitigation to include the following activities:

- Avoid the impact altogether by not taking a certain action or parts of an action
- Minimize impacts by limiting the degree or magnitude of the action and its implementation
- Repair, rehabilitate, or restore the affected environment
- Reduce or eliminate impacts over time by preservation or maintenance operations during the life of the action
- Compensate for the impact by replacing or substituting resources or environments

As indicated in Chapter 4, most of the impacts from the alternatives would be small. Activities proposed under the alternatives would follow standard Naval Nuclear Propulsion Program (NNPP) procedures and management practices for minimizing impacts and are described in Chapter 4. In addition, NNPP standards for construction and operation of facilities incorporate engineered and administrative controls to minimize impacts to the environment, workers, and the public. Furthermore, activities performed would comply with applicable laws and regulations, including obtaining appropriate construction and operating permits. A description of the pertinent laws and regulations is included in Appendix C. Some specific mitigation measures may be identified through the permit process. For the proposed action, complying with permits, following standard procedures and management practices, and implementing best management practices, when applicable, are considered part of normal practices and are not included in this section as mitigation measures.

After the publication of the Record of Decision (ROD), the NNPP will prepare a Mitigation Action Plan (MAP) to track mitigation commitments. The MAP will explain the planned mitigation measures and the monitoring needed to ensure compliance. These measures are expected to include actions identified during consultation with agencies (Appendix B), and actions where credit is taken for reducing impacts. The expected mitigation measures are listed below.

6.1 Mitigations Identified Through Consultation (Appendix B)

Mitigation commitments resulting from consultations with the State Historic Preservation Office (SHPO) and Tribal Government (Appendix B) are listed below:

1. Idaho State Historical Society Compliance Archeologist concurred with recommendation of no adverse effect if “Recommendations for Additional Project Measures” as identified in Section 8.3 of the 2013 Cultural Resources Investigations Report (INL 2013d) are adopted. A subset of the recommendations that meet the definition for mitigation measures are:

    a. Monitor sensitive archaeological resources located in proximity to the three defined direct areas of potential effect (APEs) for indirect impacts and implement protective measures if warranted;
    b. Conduct cultural resource sensitivity training for personnel to discourage unauthorized artifact collection, off-road vehicle use, and other activities that may impact cultural resources;
    c. Implement a Stop Work Procedure to guide the assessment and protection of any unanticipated discoveries of cultural materials during construction and operations.

2. In accordance with consultation with the Shoshone-Bannock Tribes documented in Appendix B, provide the Shoshone-Bannock Tribes Heritage Tribal Office the opportunity to

monitor key ground-disturbing activities that occur at NRF in support of the recapitalization activities.

6.2 Mitigations Where Credit is Taken for Impact Reduction

Most Best Management Practices (BMPs) identified in the EIS that are part of adopted plans for the DOE, INL, or NRF; contractor stipulations; or listed in standard operating procedures (SOPs) are not considered a mitigation. Additional BMPs, where credit is taken for reducing an impact in this EIS are listed below:

1. Use of high-performance generators (Tier-4) credited to reduce non-radiological air emissions in Section 4.6.

7.0 ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

This section discusses the environmental measurement and monitoring programs that would be in place for the proposed action at the Idaho National Laboratory (INL). Most of the land included within the boundaries of INL is under the jurisdiction of the United States (U.S.) Department of Energy's (DOE) Idaho Operations Office. However, lands within and around the Naval Reactors Facility (NRF) are administered by the U.S. DOE Office of Naval Reactors, Idaho Branch Office.

NRF maintains a comprehensive multimedia environmental monitoring program covering all aspects of NRF operations. This program has been developed to detect any environmental effects that may result from ongoing site operations and to demonstrate compliance with applicable federal and state environmental requirements. Data from the monitoring programs demonstrate that operating procedures used at NRF adequately protect the environment. Environmental monitoring is a key aspect of mitigating potentially adverse impacts that may result from the proposed action.

The environmental monitoring program includes monitoring performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and non-CERCLA monitoring of industrial and sanitary liquid effluents, sediment, gaseous and particulate airborne emissions, soil and vegetation, drinking water, groundwater, soil gas, and environmental radiation levels. Evaluation of the environmental data indicates that NRF operations continue to have no adverse effect on the environment. A detailed description of environmental monitoring program results is provided to the Idaho Department of Environmental Quality (IDEQ) and the Environmental Protection Agency (EPA) in NRF's annual Environmental Monitoring Report (EMR). Copies of the annual EMR (e.g., BMPC 2010) are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries.

For the proposed action, the current environmental measurement and monitoring program at NRF would be in place regardless of which alternative is chosen or where a potential new facility is located on NRF. The sampling plans in the NRF environmental measurement and monitoring program could change in response to updated regulatory requirements or new discharge points. Any abnormal monitoring results would be investigated to determine the cause and to ensure that state and federal limits would not be exceeded.

NRF uses a variety of training, controls, checks and cross-checks, audits, and inspections to maintain high standards of environmental control: (1) all personnel receive general awareness training, (2) each worker is trained in appropriate controls as they relate to their specific job, (3) written procedures must be followed verbatim, (4) dedicated technicians and supervisors oversee all environmental monitoring and related work, (5) NRF maintains an audit program that covers all environmental requirements and includes in-depth audits of specific areas, and (6) U.S. DOE Office of Naval Reactors, Idaho Branch Office maintains a technical staff, which audits and reviews NRF environmental controls. Naval Nuclear Propulsion Program (NNPP) headquarters personnel also conduct periodic in-depth inspections of these areas.

In addition, various aspects of the NRF environmental monitoring program are independently reviewed by other government agencies. A complete listing of inspections performed between 2005 and 2014 at NRF by IDEQ or federal agencies is outlined in Table 7.0-1. No significant item of non-compliance in operations has been cited as a result of these inspections.

The following sections describe the aspects of the environmental measurement and monitoring programs in place at NRF.

Table 7.0-1: Environmental Inspections and Visits of the NRF Site

Topic	Date	Agency
Industrial Waste Ditch (IWD) Inspection	2005 (April)	IDEQ
INL Oversight	2005 (May)	IDEQ
INL Oversight	2005 (July)	IDEQ
Comprehensive Environmental Response Compensation, and Liability Act (CERCLA)	2005 (September)	EPA (Region 10)
CERCLA	2005 (October)	EPA (Region 10)
INL Oversight	2005 (October)	IDEQ
Resource Conservation Recovery Act (RCRA)	2006 (February)	IDEQ
INL Oversight	2006 (June)	IDEQ
Clean Air Act Title V Inspection	2006 (August)	IDEQ
INL Oversight	2006 (October)	IDEQ
IWD Inspection	2007 (June)	IDEQ
INL Oversight	2007 (May)	IDEQ
Federal Facility Agreement and Consent Order (FFA/CO) (CERCLA)	2008 (April)	IDEQ/EPA (Region 10)
RCRA	2008 (May)	IDEQ
INL Oversight	2008 (May)	IDEQ
IWD Inspection	2008 (June)	IDEQ
RCRA	2009 (June)	IDEQ
IWD Inspection	2009 (June)	IDEQ
INL Oversight	2009 (September)	IDEQ
Clean Air Act Title V Inspection	2009 (September)	IDEQ
FFA/CO (CERCLA)	2009 (November)	IDEQ
RCRA	2010 (May)	IDEQ
IWD Inspection	2010 (September)	IDEQ
Sanitary Survey	2010 (October)	IDEQ
INL Oversight	2010 (December)	IDEQ
Hazardous Waste Compliance Inspection	2011 (May)	IDEQ
CERCLA Site NRF-43 Review	2011 (July)	IDEQ
IWD Inspection	2011 (July)	IDEQ
Air Sources Inspection	2011 (September)	IDEQ
Familiarization with Expended Core Facility (ECF) Processes	2011 (September)	EPA
Inspection of NRF CERCLA Sites (to support future 5-year reviews)	2011 (September)	IDEQ/EPA
IWD Inspection	2012 (September)	IDEQ
Clean Air Act Title V Inspection	2012 (September)	IDEQ
Hazardous Waste Compliance Inspection	2013 (May)	IDEQ
IWD Inspection	2013 (September)	IDEQ
Hazardous Waste Compliance Inspection	2014 (May)	IDEQ
Inspection of NRF CERCLA sites	2014 (May)	IDEQ
IWD Inspection	2014 (September)	IDEQ

7.1 Radiological Air Emissions Sampling and Analysis Plan

The existing radiological air emissions sampling plan would be used to monitor radiological air emissions at NRF. The radiological air emissions sampling plan could change over time in response to updated regulatory requirements or new discharge points. The plan ensures that representative samples are collected to characterize the emissions. The analysis plan requires that the samples are analyzed for constituents of concern and that analysis results are properly evaluated and reported. The analysis results are provided to IDEQ and the EPA in NRF's annual EMR. Copies of the annual EMR are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries.

Airborne exhaust from radiological work areas of NRF buildings is monitored by various sampling systems; exhaust points are monitored for particulate radioactivity. Exhaust points are monitored for tritium and radioiodine only when there is adequate potential that they may be detected. Some gaseous radionuclides cannot be sampled, so emissions of these are determined by process knowledge and production rates. Background samples are also collected when appropriate to determine the concentration of airborne pollutants that are naturally occurring or that are present due to the operations on INL. Table 7.1-1 provides a description of the sampling matrix for airborne effluent samples.

Table 7.1-1: Radiological Air Emissions Sampling Matrix

Sample Type	Sample Collection Frequency
Airborne Radioactive Particulate[1]	Weekly
Gaseous Tritium Radioactivity	Monthly
Gaseous Radioiodine Radioactivity	Weekly
Airborne Radioactive Particulate for High-Efficiency Particulate Air (HEPA)-Filtered Sources	Biweekly
[1] ECF roof vents	

As described in Section 4.6, emissions would be well below federal limits. Any abnormal monitoring results would be investigated to determine the cause and to ensure that state and federal limits would not be exceeded. The NRF radiological air emissions sampling plan ensures compliance with federal, state, local, and NNPP requirements.

7.2 Non-Radiological Air Emissions Sampling and Analysis Plan

The existing non-radiological air emissions sampling plan would be used to monitor emissions of regulated air pollutants (excluding radiological air emissions as discussed in 7.1). The non-radiological air emissions sampling plan could change over time in response to updated regulatory requirements or new discharge points. The plan ensures that appropriate methods are used to characterize emissions and properly evaluate and report results.

A variety of processes could produce non-radiological air emissions for the proposed project. Air emission points that exhaust regulated air pollutants could include the following:

- Ventilation exhausts or stacks – emit toxic and criteria pollutants
- Site boilers – emit nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM_{10}), hydrogen chloride (HCl), mercury (Hg), carbon monoxide (CO), greenhouse gases (GHGs), and volatile organic compounds (VOCs)
- Emergency generators – emit standard fuel combustion constituents

Emissions of non-radiological air pollutants are determined with a variety of methods utilizing process knowledge, emission factors, fuel consumption rate, and trained observers. Some types of non-radiological monitoring which occur at NRF are shown in Table 7.2-1.

Table 7.2-1: Non-Radiological Air Emission Sampling Matrix

Sample Type	Sample Collection Frequency
Visible Emission Inspection	Quarterly
Method 9 Opacity Reading[1]	Annually
Calculated SOx, NOx, PM_{10}, VOCs	Monthly and/or Annually
Fugitive Dust Inspection	Quarterly
[1] This is an EPA procedure where an individual judges how opaque smoke is from an emission point.	

The analysis results are provided to IDEQ and the EPA in NRF's annual EMR. Copies of the annual EMR are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries. Emissions are well below allowable levels. Any abnormal monitoring results would be investigated to determine the cause and to ensure that state and federal limits would not be exceeded. The NRF non-radiological air emissions sampling plan ensures compliance with federal, state, local, and NNPP requirements.

7.3 Liquid Effluent Monitoring

The existing liquid effluent plan would be used to monitor the liquid effluent waste streams. The liquid effluent plan could change over time in response to updated regulatory requirements or new discharge points. The plan ensures that representative samples are collected to characterize these effluent streams. Analytical results are provided to the appropriate personnel for evaluation and regulatory reporting as necessary. In addition, the analysis results are provided to IDEQ and/or the EPA in NRF's annual EMR and the Annual Reuse Site Performance Report for NRF Industrial Reuse Permit. Copies of the annual EMR are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries. The NRF liquid effluent monitoring system ensures compliance with federal, state, local, and NNPP requirements.

Systems that contain radioactive liquids with beta-, gamma-, and alpha-emitting radionuclides are not discharged to the environment. They are physically isolated from systems that discharge into the IWD or active sewage lagoons. Operational procedures are used from the start of operations to control the release of radioactive materials. Samples collected at or near the IWD or active sewage lagoons confirm that NRF is not deliberately or inadvertently releasing radionuclides into the environment. Liquid effluent samples are analyzed to characterize the discharge into the IWD or active sewage lagoons.

7.4 Groundwater Monitoring

The existing NRF groundwater monitoring system ensures compliance with federal, state, local, and NNPP requirements. The objective of groundwater monitoring is to collect groundwater data that are the most representative of existing groundwater conditions. Groundwater samples from on-site monitoring are collected for all required parameters. The locations of the groundwater monitoring wells at NRF are discussed in Section 3.4 and are shown in Figure 3.4-14.

A targeted sampling approach is used to monitor the upper 15 meters (50 feet) of the aquifer. This zone is believed to possess the highest probability of containing potential contaminants, which may be introduced as a result of operations. Groundwater samples are analyzed for VOCs, semi-volatile organic compounds, water quality constituents (e.g., pH, conductivity, etc.), inorganic compounds (e.g., heavy metals, cations, anions, etc.), nutrients (e.g., nitrates, etc.), and radionuclides. The aquifer groundwater samples are analyzed using EPA and other methods. The analysis results are provided to IDEQ and the EPA in NRF's annual EMR. CERCLA-related environmental monitoring data are discussed annually in the Institutional Control Monitoring Report (ICMR) and undergo a robust analysis associated with the 5-year review process. Copies of the NRF annual EMR, the ICMR, and the Five-Year Review Report are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries.

7.5 Drinking Water

The NRF drinking water system is currently monitored to ensure compliance with federal, state, local, and NNPP requirements. The NRF drinking water system is monitored for chemical, inorganics, organics, radiological, and bacteriological contamination. The drinking water system at NRF is in compliance with state regulations defined in the Idaho Rules for Public Drinking Water Systems, Idaho Administrative Procedures Act (IDAPA) 58.01.08. The drinking water analytical results are provided to IDEQ directly from the analytical laboratory.

7.6 Soil and Vegetation Monitoring

The NRF soil and vegetation monitoring ensures compliance with federal, state, local, and NNPP requirements. The purpose of the soil and vegetation monitoring is to:

- Radiologically characterize the surface soils to ensure that the area does not impact the ambient environment.
- Radiologically characterize the surface soils of historical radiological discharge areas and periodically update these characterizations to accurately measure changes in radiological data.
- Provide baseline radiological soil data to estimate fugitive air emissions released from the property.
- Measure potential radiological uptake by vegetative matter near the proposed sites.

Areas containing soil and vegetation outside the NRF security fence are targeted for soil and vegetation monitoring. These areas are broken into sampling blocks and sampled annually. Vegetation and soil samples are collected in the same vicinity. Vegetation samples and soil samples consist of 100 grams (0.22 pounds) and 300 grams (0.66 pounds) of the sampled material, respectively. These samples are analyzed at NRF to identify radiological activity. The analysis results are provided to IDEQ and the EPA in NRF's annual EMR. Copies of the annual EMR are also available in INL outreach offices and reading rooms in Boise and Idaho Falls as well as in public libraries.

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12.0 GLOSSARY

Terms in this glossary are defined based on the context in which they are used in this Environmental Impact Statement.

100-Year Flood: A flood event of such magnitude it occurs, on average, every 100 years (equates to a 1 percent probability of occurring in any given year).

500-Year Flood: A flood event of such magnitude it occurs, on average, every 500 years (equates to a 0.2 percent probability of occurring in any given year).

Abnormal Condition: Any deviation from normal conditions.

Aboriginal: Being the first or earliest known of its kind present in a region.

Accident: An unplanned event or sequence of events that results in undesirable consequences.

Actinide: Any of a series of chemically similar radioactive elements with atomic numbers ranging from actinium-89 through lawrencium-103. Includes uranium and plutonium.

Activation: The process of making a material radioactive by exposing the material to neutrons, protons, or other nuclear particles.

Activity: A measure of the rate at which a material is emitting nuclear radiation. Usually, activity is measured in terms of the number of nuclear disintegrations, which occur in a quantity of material over a period of time. The standard unit of activity is the Curie (Ci), which is equal to 37 billion (3.7×10^{10}) disintegrations per second.

Aggregates: Sand or pebbles added to cement in making concrete.

Airborne Emissions, Radiological: Radioactivity, in the form of radioactive particles, gases, or both, that is transported by air.

Albedo: Diffuse reflectivity or reflecting power of a surface. The ratio of reflected radiation from the surface to incident radiation upon it.

Alluvium (alluvial): Unconsolidated, poorly sorted detrital sediments (materials from preexisting igneous, metamorphic, or sedimentary rocks) deposited by streams and ranging in size from clay to gravel.

Alternatives (with respect to the National Environmental Policy Act (NEPA)): A range of reasonable options considered in selecting an approach to meeting the purpose and need.

Anion: A negatively charged ion (atom or molecule).

Aquifer: A body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.

As Low As Reasonably Achievable (ALARA): The approach to radiation protection to manage and control radiation exposures to workers and the public as low as can be reasonably achieved taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits as is reasonably achievable.

Attainment Area: An area that the U.S. Environmental Protection Agency (EPA) has designated as being in compliance with one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (See **National Ambient Air Quality Standards, Nonattainment Area, and Particulate Matter**.)

Attenuation: A decrease in intensity or amount of a substance (or noise) due to time, distance, or mass.

Background: An air concentration value, based on measured pollutant data, that accounts for the impact of emissions from natural and existing sources.

Background Radiation: Radiation from cosmic sources; naturally occurring radioactive materials, including radon and its progeny; global fallout from the testing of nuclear explosive devices; and consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation.

Basalt: The most common volcanic rock, dark gray to black in color, high in iron and magnesium, low in silica, typically found in lava flows.

Baseline: A measurement, calculation, or location used as a basis of comparison.

Basin and Range Deformation: Folding and faulting of rock strata to create mountains common to the Great Basin province.

Becquerel (Bq): A basic unit used to describe the intensity of radioactivity in a sample of material. A unit of radioactivity; the amount of any nuclide that undergoes exactly one radioactive disintegration per second. One Curie is equal to 3.7×10^{10} Bq.

Best Management Practices: Structural, non-structural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of the environment. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. Best Management Practices are also used to minimize spread of contamination to keep radiation exposures as low as reasonably achievable. Best Management Practices can include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to reduce fugitive dust or to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. Best Management Practices are also used in worker protection, such as the requirement of hearing protection when noise levels reach specified levels, and the posting of hearing protection areas with the range of noise levels expected and the allowed exposure times at these levels.

Beta Particle: A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron.

Biface: A stone tool having opposite sides or faces worked on to form an edge for cutting or scraping.

Biodiversity: The degree of variation of life forms within a given ecosystem.

Biomass: The total mass of all living organisms (producers, consumers, decomposers) or of a particular set (e.g., species), present in an ecosystem or at a particular trophic level in a food-chain, and usually expressed as dry weight or, more accurately, as the carbon, nitrogen, or calorific content per unit area.

Biota: Plants and animals occupying a place together (e.g. terrestrial biota, marine biota).

Borrow Pit: An area designated as the excavation site for geologic resources, such as rock/basalt, sand, gravel, or soil, that are to be used elsewhere (e.g., for fill).

Bounding Case: The worst case scenario. The Council on Environmental Quality (CEQ) originally mandated a worst case analysis to predict the worst possible environmental consequences of a proposed federal action. CEQ currently requires discussion in an EIS of a potential environmental effect only upon demonstration through "credible scientific evidence" that is reasonably foreseeable.

Calcareous Silt: Sediment containing calcium carbonate, calcium, or lime.

Calcining: Heating to a high temperature without fusing or heating ores, precipitates, concentrates, or residues so that hydrates, carbonates, or other compounds are decomposed and volatile material is expelled.

Caldera: A large basin-shaped volcanic depression that has a diameter that is much larger than the individual volcanic vents that are included within it. Calderas are made by volcanic eruptions and explosions or erosion.

Carbon Dioxide: A colorless, odorless gas that is a normal component of ambient air; it results from fossil fuel combustion, and is a respiration product from mammals.

Carbon Monoxide: A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

Cation: A positively charged ion (atom or molecule).

Characterization: The determination of waste composition and properties, whether by review of process knowledge, non-destructive examinations or assay, or sampling and analysis; generally done for purposes of determining appropriate storage, treatment, handling, transport, and disposal requirements.

Chenopod: Weedy plants of the goosefoot family.

Cladding, Fuel: A metal casing that surrounds the nuclear fuel.

Class I Areas: A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks, wilderness areas). (See **Prevention of Significant Deterioration**.)

Class II Areas: Any other area not designated as Class I is initially designated as Class II. Class II areas are generally cleaner than air quality standards require, and moderate increases in new pollution are allowed after a regulatory mandated impacts review.

Code of Federal Regulations (C.F.R.): Published regulations presenting the official and complete text of agency regulations in one organized publication, providing a comprehensive and convenient reference for all those who may need to know the text of general and permanent federal regulations.

Climatology: The science that deals with climates and their phenomena.

Collective Dose: The sum of the individual doses received in a given period of time by a specified population. The unit of collective dose is person-Sievert or person-rem. For example, 1000 people who each receive a 0.01 Sievert (1 rem) dose, receive a collective dose of 10 person-Sievert (1000 person-rem).

Committed Effective Dose: A radiation dose following an intake of radioactive material by inhalation or ingestion. The dose is assigned to an individual at the time of intake but will accumulate over the lifetime of the individual.

Community (biotic): A general term applied to any grouping of populations of different organisms found living together in a particular environment; essentially, the biotic component of an ecosystem.

Computed Tomography: Radiography in which a three-dimensional image of a body structure is constructed by computer from a series of plane cross-sectional images made along an axis.

Conductivity: The relative ability of materials to carry an electric current.

Contact-Handled Low-Level Waste: Packaged radioactive waste whose external surface dose rate does not exceed 2 milliSievert (200 millirem) per hour.

Conformity: Conformity is defined in the Clean Air Act as the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, and achieving expeditious attainment of such standards; and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reduction, or other milestones in any area.

Containment, Radioactive Contamination: Devices as complex as a glove box or as simple as a plastic bag designed to limit the spread of radioactive contamination to an area as close as possible to the source and to prevent contaminating other material.

Contamination: The presence of unwanted material in air, soils, water, or on the surfaces of structures, objects, or personnel.

Core: The central portion of a nuclear reactor containing the nuclear fuel.

Corrosion Products: The radionuclides formed as a result of a material being activated. For example, cobalt-60 (^{60}Co) is a corrosion product resulting from neutron activation of cobalt-59 (^{59}Co).

Cosmic Radiation: Radiation originating from space (beyond Earth).

Criteria Pollutant: An air pollutant that is regulated by National Ambient Air Quality Standards. The EPA must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter: less than or equal to 10 micrometers (0.0004 inch) in diameter, also known as PM_{10}; and less than or equal to 2.5 micrometers (0.0001 inch) in diameter, also known as $PM_{2.5}$. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (See **National Ambient Air Quality Standards**.)

Critical Habitat: Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 C.F.R. § 424). (See **Endangered Species and Threatened Species**.) The lists of Critical Habitats can be found in 50 C.F.R. § 17.95 (fish and wildlife), 50 C.F.R. § 17.96 (plants), and 50 C.F.R. § 226 (marine species).

Critical Mass: Critical mass is achieved when there are sufficient neutrons present in a fissile material to create a nuclear chain reaction.

Criticality: A self-sustaining chain reaction, which releases neutrons and energy, and generates radioactive by-product material.

Cumulative Impacts: Impacts on the environment that result when the incremental impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Curie (Ci): The basic unit used to describe the intensity of radioactivity in a sample of material. A unit of radioactivity; the amount of any nuclide that undergoes exactly 3.7×10^{10} radioactive disintegrations per second (Bq).

Decay Heat: Heat generated during the radioactive decay process.

Decay Product: A nuclide resulting from the radioactive decay of a parent isotope or precursor nuclide.

Decay, Radioactive: The process in which one radionuclide spontaneously transforms into one or more different radionuclides called decay products. The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha or beta particles, often accompanied by gamma radiation.

Decibel: A unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average level at which sound causes pain to humans.

Decontamination: The action taken to reduce or remove substances that present a substantial current or potential future hazard to human health or the environment, such as radioactive contamination from facilities, soil, or equipment by washing, chemical action, mechanical cleaning, or other techniques.

Deionized Water: Water that has been purified from all other ions except for hydronium and hydroxide.

Demineralization: Removal of minerals from water.

Dielectric: A material which is an electrical insulator or in which an electric field can be sustained with a minimum dissipation of power.

Dike (intrusion): A tabular body of igneous rock that was injected into a fissure when molten that cuts across the structure of the adjacent rock.

Direct Impact or Effect: Direct environmental impacts or effects are caused by the action and occur at the same time and place.

Dispersion: The process of scattering or distributing over a large region.

DOE Orders: Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

Dome: A geological symmetrical structural uplift having an approximate circular outline in plan view with the geologic beds dipping outwardly and approximately equally from the center, or high point of the uplifted rock formations.

DOP Testing: DOP (dioctylphthalate) testing is a test that monitors penetration of a test agent through a filter and any gaps in the housing of the filter.

Dose: The quantity of radiation or energy absorbed; usually expressed in Sievert or rem for doses to humans. One Sievert is equivalent to 100 rem.

Dose Rate: The amount of radiation dose delivered in a unit amount of time (e.g., rem/hr).

Dosimetry: Determination of cumulative radiation dose. The term is also used to describe devices used to measure the amount of radiation dose.

Dry Storage: Storage of spent nuclear fuel in environments where the fuel is not immersed in liquid for purposes of cooling and/or shielding.

Dust Devil: A small whirlwind containing sand or dust.

Ecology: A branch of science dealing with the inter-relationships of living organisms with one another and with their non-living environment.

Ecosystem: A community of organisms and their physical environment interacting as an ecological unit.

Effective Dose: A radiation dose that is obtained during exposure to an external radiation field.

Effluent: A waste stream flowing into air, surface water, groundwater, or soil. Most frequently, it applies to wastes discharged to surface waters.

Emigration: The act of leaving one country or region to settle in another.

Endangered Species: Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 C.F.R. § 424). (See **Threatened Species**.) The lists of endangered species can be found in 50 C.F.R. § 17.11 for wildlife, 50 C.F.R. § 17.12 for plants, and 50 C.F.R. § 222.23(a) for marine organisms.

Endemic: Native of a particular region.

Endowment: The part of an institution's income derived from donations.

Environmental Impact Statement: The detailed written statement required by NEPA Section 102(2)(C) for a proposed major federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality National Environmental Policy Act regulations in 40 C.F.R. § 1500-1508 and DOE NEPA-implementing procedures in 10 C.F.R. § 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

Equivalent Dose: A quantity used to express all radiation on a common scale for calculating the effective dose. It is the number that is recorded as representing an individual's dose from external radiation sources or internally deposited radioactive materials. The equivalent dose quantity is used for comparing the biological effects of different types of radiation on a common scale. For exposure to humans, equivalent dose is commonly expressed in rem.

Erythema: Redness of the skin.

Ethnobotanical: Relating to the science that studies the interaction of humans and plants.

Ethnography: The study of human cultural systems or ways of life and how those systems relate to subsistence, resource use, and technology.

Evapotranspiration: A combined term for water lost as vapor from a soil or open water surface (evaporation) and water lost from the surface of a plant, mainly via the stomata (transpiration). The combined term is used since in practice it is very difficult to distinguish water vapor from these two sources in water-balance and atmospheric studies.

Exposure, Background: Exposure from natural ionizing radiation.

Exposure, External: Exposure from ionizing radiation originating outside the body.

Exposure, Internal: Exposure from ionizing radiation originating inside the body.

Exposure, Occupational: Exposure from ionizing radiation incurred during the course of employment.

Exposure, Radiation: The condition of being subject to the effects of or potentially acquiring a dose of radiation. The incidence of radiation on living or inanimate material by accident or intent; subjecting a material or organism to ionizing radiation.

Extirpation: Complete removal or destruction.

Facultative: Capable of supporting varying biological conditions.

Fallout: Airborne radioactive particles or dust that fall to ground.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall (rock over the fault) has been depressed in relation to the footwall (rock under the fault). A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

Fauna: Animals of a specified region or time.

Fission: The splitting of a heavy nucleus into two approximately equal parts, which is accompanied by the release of a relatively large amount of energy and generally one or more neutrons.

Fission Products: During the operation of a nuclear reactor, heat is produced by the fission (splitting) of “heavy” atoms, such as uranium, plutonium, or thorium. The residue left after splitting of these “heavy” atoms is a series of intermediate weight atoms generally termed “fission products.” Because of the nature of the fission process, many fission products are unstable and, hence, radioactive. Radioactive or non-radioactive atoms produced by the fission of heavy atoms.

Fissionable Material: Commonly used as a synonym for fissile material, the meaning of this term has been extended to include material that can be fissioned by fast neutrons, such as uranium-238 (^{238}U).

Fissile Material: See **Fissionable Material.**

Flood Frequency: Typically characterized by the recurrence interval of a flood (or flow). This term is the average period of time that elapses between floods of a given size. Larger floods are more infrequent; and, therefore, have a larger recurrence interval. Recurrence intervals are calculated based on historical measurements of flow and on geologic evidence of flooding.

Floodplains: Floodplains include, at a minimum, the area that has at least a 1 percent chance of being inundated by a flood in any given year. Such a flood is known as a 100-year flood. The area that has a 0.2 percent or more chance of being flooded in any given year is known as a 500-year floodplain.

Flora: Plants of a specified region or time.

Fluoroscopy: Observing the internal structure of an opaque object (as the living body) by means of X-rays.

Fluvial: Produced by the action of flowing water.

Footprint: An area of ground that is covered by a structure or a piece of equipment.

Forb: Any herbaceous plant other than a grass, especially one growing in a field or a meadow.

Fugitive Dust: A type of non-point source air pollution that originates in small quantities over large areas.

Gamma Ray: High energy, short wavelength electromagnetic radiation. Gamma rays are very penetrating and are stopped most effectively by dense materials such as concrete or lead. They are similar to X-rays, but are usually more energetic. Cobalt-60 (^{60}Co) is an example of a radionuclide that emits gamma rays.

GENII: A computer code used for environmental transport and exposure assessment calculations for routine naval spent nuclear fuel handling operations and surface water transport and exposure for hypothetical accident scenarios.

Geochemical: Dealing with the chemical composition of the Earth's crust and the chemical changes that occur there.

Geologic Repository: A system that is intended to be used for, or may be used for, the disposal of radioactive waste or spent nuclear fuel in excavated geologic media. A geologic repository includes (a) the geologic repository operations area and (b) the portion of the geologic setting that provides isolation. A near-surface disposal area is not a geologic repository.

Geophysical: Relating to the physics of the Earth.

Geotechnical: A term used to describe the engineering behavior of rock samples and slopes in the ground.

Greenhouse Gases: Gases that absorb long-wave radiation and therefore contribute to greenhouse effect warming when present in the atmosphere. The principal greenhouse gases are water vapor, carbon dioxide, methane, nitrous oxide, halocarbons, and ozone.

Gross Alpha/Beta Activity: Measurement of all alpha and beta activity present, regardless of specific radionuclide source.

Groundwater: Water below the ground surface in a zone of saturation. Water, held below the water table, available to enter wells freely.

Grub: To clear a surface (e.g., ground or soil) of roots and stumps.

Habitat: The environment occupied by individuals of a particular species, population, or community characterized by its physical or biotic properties.

Half-Life, Radiological: The time required for half of the atoms of a radioactive material to decay to another nuclear form. Half-lives range from millionths of a second to billions of years depending on the stability of the nuclei.

Handling (of naval spent nuclear fuel): Naval spent nuclear fuel handing activities include unloading shipping containers, temporary wet or dry storage, initial examination, resizing the naval spent nuclear fuel, securing neutron poison, and loading naval spent nuclear fuel canisters.

Hazardous Air Pollutants: Air pollutants not covered by ambient air quality standards but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 C.F.R. § 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 189 pollutants listed in or pursuant to the Clean Air Act, Section 112(b). Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

Hazardous Chemical: As defined in 29 C.F.R. 1910.1200, any chemical which is classified as a physical hazard or health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.

Hazardous Waste: As defined in 40 C.F.R. 261.3, a hazardous waste is a solid waste that exhibits at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or is specifically listed in 40 C.F.R. 261, Subpart D. Source, special nuclear material, and by-product material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste and are therefore not hazardous wastes.

Heavy Metals: High-density metals (specific gravity of approximately 5.0 or higher) that can sometimes be poisonous (e.g. mercury, lead).

Heterogeneities: Differences in structure or quality; dissimilarities.

High-Efficiency Particulate Air filter: A filter with an efficiency of at least 99.95 percent used to separate particles from air exhaust streams prior to releasing that air into the atmosphere.

High-Level Waste: The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from the reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include other highly radioactive material that the U.S. Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation.

Hydrogeology: The study of the geological factors relating to water.

Hydrology: The science dealing with the properties, distribution, and circulation of natural water systems.

Idaho National Laboratory (INL): Formerly known as Idaho National Engineering and Environmental Laboratory, INL is a DOE laboratory complex located in southeast Idaho about 25 miles west of Idaho Falls, that is managed and operated under contract to DOE.

Igneous: Rocks formed by solidification from a molten state.

Indirect Impact or Effect: Environmental impacts or effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems, including ecosystems.

Inorganic Compound: A chemistry term used to define chemical compounds that do not contain carbon as the principal element (excepting carbonates, cyanides and cyanates), that is, matter other than plant or animal.

Interbedded: Geologically, occurring between beds (layers) or lying in a bed parallel to other beds of a different material.

Intermittent: A stream that only flows part of the time in response to rainfall or wet conditions.

Ion: An atom or molecule that has acquired an electrical charge by gaining or losing electrons.

Ion-Exchange Resin: A material used for water purification.

Ionizing Radiation: Radiation that has sufficient energy to displace electrons from atoms or molecules to produce ions. The ions have the ability to interact with other atoms or molecules; in biological systems, this interaction can cause damage in tissue or to an organism.

Irradiate: To expose to ionizing radiation.

Isotope: One of two or more nuclides, which have the same number of protons but have different numbers of neutrons in their nuclei. Isotopes usually have very nearly the same chemical properties but somewhat different physical properties.

Lee Side: The side of a geographical feature which is sheltered from the wind.

Lek: A territory that is held and defended against rivals by males of a certain species during the breeding season. For a local population of a species, leks are usually grouped together within a breeding area; and dominant males tend to occupy the more central leks, where their displays can be seen by the largest number of females.

Limit State: A description of the extent of damage that an system, structure, or component may experience and still perform its intended safety function.

Liquefaction: Being changed into a liquid.

Lithic Scatter: A surface scatter of cultural artifacts and debris that consists entirely of lithic (i.e., stone) tools and chipped stone debris.

Loess: A uniform wind-deposited accumulation of silty material having an open structure and relatively high cohesion due to cementation by clay or calcium-carbonate materials.

Low-Level Waste: Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel. Test specimens of fissionable material irradiated for research and development only and not for the production of power or plutonium may be classified as low-level waste, provided the concentration of transuranic elements is less than 100 nanocuries per gram of waste.

M-140 and M-290 Shipping Containers: Naval spent nuclear fuel transportation casks certified to 10 C.F.R. § 71 requirements and used for rail transportation.

Magma: Liquid or molten rock which solidifies to produce igneous rock when cooled.

Mafic: Pertaining to or composed dominantly of the ferromagnesian rock-forming silicates.

Maximum Contaminant Level (MCL): The designation for EPA standards for drinking water quality under the Safe Drinking Water Act. The MCL for a given substance is the maximum permissible concentration of that substance in water delivered by a public water system. The primary MCLs (40 C.F.R. § 141) are intended to protect public health and are federally enforceable. They are based on health factors but are also required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. Secondary MCLs (40 C.F.R. § 143) are set by the EPA to protect the public welfare. The secondary drinking water regulations control substances in drinking water that primarily affect aesthetic qualities (such as taste, odor, and color) related to the public acceptance of water.

Mesonet: Network of automated weather stations designed to observe mesoscale meteorological phenomena.

Mesophyll: Photosynthetic tissue of a leaf, located between the upper and lower epidermis.

Metallographic Examination: Examination in which metal coupons are sectioned, ground, polished, and etched to perform inspections of cross-sections of qualification welds.

Meteorology: The atmospheric phenomena and weather of a region.

Metric Tons of Heavy Metal: Quantities of unirradiated and spent nuclear fuel are traditionally expressed in terms of metric tons of heavy metal (typically uranium), without the inclusion of other materials, such as cladding, alloy materials, and structural materials. A metric ton is 1000 kilograms, which is equal to about 2200 pounds.

Mitigate: Mitigation includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Mixed Waste: Waste that contains hazardous waste (as defined under the Resource Conservation and Recovery Act) and radioactive waste (subject to the Atomic Energy Act of 1954).

Montmorillonite: A hydrated silicate of magnesium, an important clay-forming mineral and a chief component of bentonite clay.

National Ambient Air Quality Standards: Standards defining the highest allowable levels of certain pollutants in the ambient air (i.e., the outdoor air to which the public has access). Because the EPA must establish the criteria for setting these standards, the regulated pollutants are called criteria pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (less than or equal to 10 micrometers (0.0004 inches) in diameter and less than or equal to 2.5 micrometers (0.0001 inches) in diameter). Primary standards are established to protect public health; secondary standards are established to protect public welfare (e.g., visibility, crops, animals, buildings). (See **Criteria Pollutant**.)

National Emission Standards for Hazardous Air Pollutants: Emissions standards set by the EPA for air pollutants which are not covered by National Ambient Air Quality Standards and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR § 61 and 63. National Emission Standards for Hazardous Air Pollutants are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, dry cleaning facilities, petroleum refineries). (See **Hazardous Air Pollutants**.)

National Pollutant Discharge Elimination System: A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the U.S. unless a special permit is issued by the EPA, a state, or, where delegated, a tribal government on an Indian reservation. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

Natural Background Radiation Exposure: The dose from cosmic radiation and radiation emitted by naturally occurring radioisotopes. Typically, an average annual exposure of 360 millirem to the total body occurs from background radiation.

Naval Nuclear Propulsion Program: A joint program of the DOE and the U.S. Department of the Navy that has as its objective the design and development of improved naval nuclear propulsion plants having high reliability, maximum simplicity, and optimum fuel life for installation in submarines and aircraft carriers. The program is frequently referred to as the Naval Reactors program.

Neutron: An uncharged particle with a mass slightly greater than that of a proton, found in the nucleus of every atom heavier than hydrogen. Neutrons sustain the fission chain reaction in a nuclear reactor. A neutron is frequently released as radiation.

Neutron Poison: Material that absorbs neutrons to ensure that nuclear fission does not occur.

Nitrates: Salts formed by the action of nitric acid on metallic oxides, hydroxides, and carbonates. Nitrates are readily soluble in water and decompose when heated.

Nitrogen Oxides: Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone.

Nonattainment Area: An area that the EPA has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others. (See **Attainment Area, National Ambient Air Quality Standards, and Particulate Matter**.)

Non-potable Water: Water not suitable for drinking.

Notice of Intent (NOI): Public announcement that an Environmental Impact Statement will be prepared. It describes the Proposed Action, possible alternatives, and scoping process, including whether, when and where scoping meetings will be held. The NOI is usually published in the Federal Register and local media. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an Environmental Impact Statement should address.

Noxious Weeds: An invasive species of a plant that has been designated by county, state, provincial, or national agricultural authorities as one that is injurious to agricultural and/or horticultural crops, natural habitats, ecosystems, humans, or livestock.

Nuclear Fuel: Materials that are fissionable and can be used in nuclear reactors to make energy.

Nuclear Radiation: Energy that is emitted from atomic nuclei in various nuclear reactions and includes alpha radiation, beta radiation, gamma radiation, and radiation from neutrons.

Nucleus (Nuclei (plural form)): Central portion of an atom.

Nuclide: An atomic form of an element, which is distinguished by its atomic number, atomic weight, and the energy state of its nucleus. These factors determine the other properties of the element, including its radioactivity.

Organic Compound: A chemistry term used to define chemical compounds based on carbon chains or rings and also containing hydrogen with or without oxygen, nitrogen, or other elements.

Particulate: Pertaining to a very small piece or part of material.

Particulate Matter (PM): Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter.

Pathway: The route or course by which radionuclides reach humans.

Perched (aquifer/groundwater): A body of groundwater of small lateral dimensions that is separated from an underlying body of groundwater by an unsaturated zone.

Permeability: The degree of ease with which water can pass through a rock or soil.

Person-rem: Unit for **Collective Dose**.

pH: A term used to describe the hydrogen-ion activity of a system; a solution of pH 0 to 7 is acid, pH of 7 is neutral, pH over 7 is alkaline. pH is of great importance in many biologic and electrolytic processes.

Photochemical: The branch of chemistry dealing with the effects of light on chemical systems.

Picocurie: A unit of radioactivity equaling 1×10^{-12} Curies.

Playa: The flat-floored bottom of an undrained desert basin that, at times, becomes a shallow lake.

Plume: The elongated volume of contaminated water or air originating at a pollutant source such as an outlet pipe or a smokestack. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

Polychlorinated Biphenyl (PCB): As defined in 40 C.F.R. 761.3, PCB means any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination of substances which contains such substance. This class of chemical substances has been banned from production since 1979. PCBs were often used as coolants and lubricants in transformers, capacitors, and other electrical equipment.

Population Dose: A summation of the radiation doses received by individuals in an exposed population; equivalent to collective dose; expressed in person-Sievert or person-rem. It is the overall dose to the off-site population.

Potable Water: Water suitable for drinking.

Prevention of Significant Deterioration (PSD): Regulations established to prevent significant deterioration of air quality in areas that already meet National Ambient Air Quality Standards. Specific details of Prevention of Significant Deterioration are found in 40 C.F.R. § 51.166. Among other provisions, cumulative increases in sulfur dioxide, nitrogen dioxide, and PM_{10} levels after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (e.g., national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 C.F.R. § 51.166 for Class III areas, if any such areas should be so designated by EPA. Class III increments are less stringent than those for Class I or Class II areas. (See **National Ambient Air Quality Standards**.)

Probable Maximum Flood: The largest flood for which there is any reasonable expectancy in a specific area. The probable maximum flood is normally several times larger than the largest flood of record. This hypothetical flow scenario is used to place an upper bound on the impacts of flooding. It is not assigned a probability, but is intended to represent the combination of events (snowmelt, precipitation, and dam failure) that could lead to maximum stream flow.

Probability: The relative frequency at which an event can occur in a defined period. Statistical probability is what happens in the real world and can be verified by observation or sampling. Knowing the exact probability of an event is usually limited by the inability to know, or compile the complete set of all possible outcomes over time or space. Probability is measured on a scale of 0 (event will not occur) to 1 (event will occur).

Processing (of naval spent nuclear fuel): See **Handling (of naval spent nuclear fuel)**.

Protected Species: Endangered and threatened species that are endangered throughout all or a significant portion of their range.

Proton: An elementary particle that is the positively charged component of ordinary matter and, together with the neutron, is the building block of all atomic nuclei.

Prototype Facilities: Land-based naval nuclear reactor plants that are typical of a first design for a naval warship and are used to test equipment and the nuclear fuel prior to use on a shipboard nuclear plant. Prototype plant facilities are also used to train naval officers and enlisted personnel as propulsion plant operators by giving them extensive watchstanding experience and a thorough knowledge of all propulsion plant systems and their operating requirements.

Pumice Bed: A geological layer of porous volcanic rock.

Quaternary Age: Comprises all geologic time from the Tertiary up to and including the present era, or approximately the last 1.9 million years.

Rad: A unit of absorbed radiation dose in terms of energy. The total energy absorbed per unit quantity of tissue is referred to as "absorbed dose" (or simply “dose”). One rad equals 100 ergs of energy absorbed per gram of tissue (0.01 joule of energy per kilogram).

Radiation: The emission and propagation of energy through matter or space as waves or particles. Radiation generally results from processes that occur naturally. The most commonly recognized form of radiation is electromagnetic radiation emitted over a specific range of wavelengths and energies. Visible light is part of the spectrum of electromagnetic radiation. Radiation of longer wavelengths and lower energy includes infrared radiation (known for heating material when the material and the radiation interact) and radio waves. Electromagnetic radiation of shorter wavelengths and higher energy (which are more penetrating) includes ultraviolet radiation (which causes sunburn) and forms of ionizing radiation, such as X-rays and gamma radiation.

Radiation Dose: The quantity of radiation or energy absorbed; usually expressed in Sievert or rem for doses to humans. One Sievert is equivalent to 100 rem.

Radiation Level: The measured amount of radiation.

Radiation Shielding: Materials that are used to reduce radiation levels from a radioactive source.

Radiation Survey: The evaluation of an area or object with instruments to detect, identify, and quantify radioactive materials and radiation fields.

Radiation Worker: A person qualified to work in radiation areas.

Radioactive: Emitting radioactivity.

Radioactive Contamination: The deposition of radioactive material on any surface.

Radioactive Waste: Equipment and materials that are radioactive and for which there is no further use. Radioactive waste is subject to the Atomic Energy Act of 1954.

Radioactivity: The property or characteristic of an unstable atom to undergo spontaneous transformation (to disintegrate or decay) with the emission of energy as radiation to reach a more stable state.

Radiochemistry: The area of chemistry concerned with the study of radioactive substances.

Radiograph: A picture produced on a sensitive surface by a form of radiation other than visible light; specifically an X-ray or gamma-ray photograph.

Radiography: The art, act, or process of making radiographs.

Radioisotope: An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and artificial isotopes have been identified.

Radiological Consequences: The changes to the environment or to the health of a person(s) as a result of exposure to radiation or radioactive materials.

Radionuclides: Atoms that exhibit radioactive properties. Standard practice for naming radionuclides is to use the number or atomic symbol and its atomic weight (e.g., cobalt-60 or ^{60}Co).

Radon: A naturally-occurring heavy radioactive gaseous element formed by the decay of radium.

Reactivity: The amount of neutrons present at a given time and their ability to sustain a nuclear chain reaction.

Recapitalization: Expenditure of funds to upgrade or build new facilities to ensure the availability of needed infrastructure.

Record of Decision (ROD): A concise public record that discusses DOE's decision, identifies the alternatives (specifying which ones were considered environmentally preferable), and indicates whether all practicable means to avoid or minimize environmental harm from the selected alternative were adopted (and if not, why not).

Region of Influence (ROI): A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur and are expected to be of consequence.

Rem: The effects of radiation exposure on humans depend on the kind of radiation received, the total amount of radiation energy absorbed, and the sensitivity and mass of tissues involved. A rem is a unit of radiation dose calculated by a formula that takes these three factors into account. Another common unit of radiation dose is the Sievert (100 rem = 1 Sievert).

Remediation: Cleanup and restoration of a contaminated site or area.

Remote-Handled Low-Level Waste: Packaged radioactive waste whose external surface dose rate exceeds 2 milliSievert (200 millirem) per hour; this waste is handled from a distance to protect human operators from unnecessary exposure.

Reprocessing (of spent nuclear fuel): Processing of reactor irradiated nuclear material (primarily spent nuclear fuel) to recover fissile and fertile material to recycle such materials, primarily for defense programs. Reprocessing involves chemical separations of elements (typically uranium or plutonium) from undesired elements in the fuel.

Resuspension: The suspension of insoluble particles after they have been deposited.

Reverse Osmosis: Filtration method that removes many types of large molecules and ions from solution by applying pressure to the solution when it is on one side of a selective membrane.

Rhizomatous: A plant species that has a creeping stem lying at or under the surface of the soil, producing roots from its undersurface.

Rhyolite: A general name given to fine-grained rocks that have a similar chemical composition to granite and are usually associated with lava flows.

Rift Zone: A system of fractures in the Earth's crust usually associated with the extrusion of lava.

Riparian: Adjacent to the bank of a river or other body of water.

Risk: The product of the probability that an undesirable event will occur and the consequences of the undesirable event.

Runoff: Portion of rainfall, melted snow, or irrigation water that flows across the ground surface and could eventually enter a surface water body.

Salmonid: Any fish of the family Salmonidae including salmon, trout, and whitefish.

Scientific Notation: A notation adopted by the scientific community to deal with very large and very small numbers by moving the decimal point to the right or left so that only one number above zero is to the left of the decimal point. Scientific notation uses a number times 10 and either a positive or negative exponent to show how many places to the right or left the decimal point has been moved. For example, in scientific notation, 120,000 would be written as 1.2×10^5, and 0.000012 would be written as 1.2×10^{-5}.

Sedimentary: Rocks formed by the accumulation of sediment in water or from the air. A characteristic feature of sedimentary deposits is its layered structure known as bedding.

Sediment: Solid material, both mineral and organic, that is in suspension and is being transported or moved from its site of origin by air, water, or ice and has come to rest on the Earth's surface either above or below sea level.

Seismic: Pertaining to any earth vibration, especially an earthquake.

Seismicity: The frequency and distribution of earthquakes.

Sequestration: The effective removal of ions from a solution by coordination with another type of ion/molecule to form complexes that do not have the same chemical behavior as the original ions.

Shielded Cell: Thick concrete walls, floors, and ceiling (stainless steel-lined) with leaded glass viewing/operating gallery windows.

Sievert: The effects of radiation exposure on humans depend on the kind of radiation received, the total amount of radiation energy absorbed, and the sensitivity and mass of tissues involved. A Sievert is a unit of radiation dose calculated by a formula that takes these three factors into account. Another common unit of radiation dose is the rem (1 Sievert = 100 rem).

Silicic: Rocks containing silica (a dioxide of silicon, such as quartz) in a dominant amount.

Sinks: Depressions in the land surface; especially ones having a central playa where there is no outlet for water.

Source Term: The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a building, location, or event. It can be expressed as a rate (i.e., amount per unit time) or amount released from a one-time event.

Special Case Waste: Waste that is owned or generated by the DOE which does not fit into typical management plans developed for the major radioactive waste types.

Special Nuclear Material: Term used by the Nuclear Regulatory Commission to classify fissile materials.

Specimen: A small sample of material (fuel or non-fuel) inserted into a reactor for testing to characterize the material's performance. Test specimens may be constructed of, but are not limited to, reactor plant materials, reactor core structural materials, or fuel materials.

Spectroscopy: The study of spectra by use of the spectroscope, an optical instrument.

Spent Nuclear Fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Stability Class: A measure of the state of atmospheric turbulence conditions.

Steppe: A level country or plain having few trees.

Stochastic Effects: Effects that may or may not occur.

Storage: The collection and containment of waste or spent nuclear fuel, in such a manner as not to constitute disposal of the waste or spent nuclear fuel, for the purposes of awaiting treatment or disposal capacity (i.e., not short-term accumulation).

Strata: A layer in which archaeological material (such as artifacts, skeletons, and dwelling remains) is found during excavation.

Sulfur Oxides: Refers to the oxides of sulfur, primarily sulfur dioxide, and to a lesser extent sulfur trioxide. Sulfur dioxide is a heavy, pungent, colorless gas formed in the combustion of fossil fuels and is considered a major air pollutant. Sulfur oxides are primary agents in the formation of acid rain. Sulfur oxides can also irritate the upper respiratory tract and cause lung damage.

Surface Water: All bodies of water on the surface of the Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

Tectonic: Of or relating to motion in the Earth's crust and occurring along geologic faults.

Terrestrial: Related to the land or the Earth.

Tertiary Period: Marks the beginning of the Cenozoic era. It began 65 million years ago and ended 1.9 million years ago.

Then-year Dollars: Cost projections escalated over time to account for inflation.

Threatened Species: Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 C.F.R. § 424) (see **Endangered Species**). The lists of threatened species can be found at 50 C.F.R. § 17.11 (wildlife), C.F.R. § 17.12 (plants), and C.F.R. § 227.4 (marine organisms).

Time Weighted Average: Concentrations of a parameter (noise for this EIS) averaged across a certain time duration, typically 8 hours.

Total Effective Dose: The sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures). The total effective dose delivered to an individual is measured in units of rem or Sievert.

Transect: To cut across or divide by cutting.

Ungulates: Mammals having hoofs.

UTM Coordinates: Universal Transverse Mercator geographic coordinate system is a grid-based method of specifying locations on the surface of the Earth that is a practical application of a two-dimensional Cartesian coordinate system.

Vadose Zone: The region of soil and rock between the ground surface and the top of the water table in which pore spaces are only partially filled with water. Over time, contaminants in the vadose zone often migrate downward to the underlying aquifer.

Vascular Plants: Plants having specialized tissues that conduct water and synthesized foods.

Vista: A distant view through or along an avenue or opening.

Volatile Organic Compound (VOC): Any of a broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures; examples are benzene, chloroform, and methyl alcohol. With regard to air pollution, any organic compound that participates in an atmospheric photochemical reaction, except those determined by the EPA Administrator to have negligible photochemical reactivity.

Vortex: A mass of fluid (as a liquid) with a whirling or circular motion that tends to form a cavity or vacuum in the center of the circle and to draw toward this cavity or vacuum bodies subject to its action; the spout of a tornado is a visible core of a vortex.

Waste Management: A systematic approach to organize, direct, document, and assess activities associated with waste generation, treatment, storage, or disposal. A waste management program consists of all the functional elements, organizations, and activities that comprise the system needed to manage waste.

Waste Minimization: An action that economically avoids or reduces the generation of waste by source reduction, reducing the toxicity of hazardous waste, improving efficiency of energy usage, or recycling. These actions are consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

Water Pool: Used for the storage of irradiated materials and spent fuel. The water shields the material being stored while allowing it to be accessible for handling.

Water Table: The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

Wet Storage: Storage of spent nuclear fuel in a water pool, generally for the purpose of cooling and/or shielding.

Wetlands: Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

X-rays: Penetrating electromagnetic radiations with wavelengths shorter than those of visible length. They are usually produced (as in medical diagnostic X-ray machines) by irradiating a metallic target with large numbers of high-energy electrons. They are essentially similar to gamma rays, but are usually less energetic and originate outside the nucleus.