DOE/EA-1562

Environmental Assessment

Construction and Operation of a Physical Sciences Facility at the Pacific Northwest National Laboratory, Richland, Washington

U.S. Department of Energy
Pacific Northwest Site Office
Richland, Washington 99352

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Summary

Introduction. This Environmental Assessment (EA) provides information and analyses of proposed U.S. Department of Energy (DOE) activities associated with constructing and operating a new Physical Sciences Facility (PSF) complex on DOE property located in Benton County, north of Richland, Washington. The proposed PSF would replace a number of existing research laboratories in the Hanford Site 300 Area that are currently occupied by Pacific Northwest National Laboratory (PNNL) and that are scheduled for removal as part of the Hanford Site cleanup. Information contained in this EA will be used by the DOE Office of Science (DOE-SC) to determine if the proposed action is a major federal action significantly affecting the quality of the human environment.

Purpose and Need. To meet long-term federal agency mission needs, DOE needs to provide replacement laboratory space and associated infrastructure for some PNNL research and development capabilities currently located in 300 Area facilities scheduled for demolition. To accomplish its scientific mission, PNNL requires a variety of facilities and equipment, including radiological and other specialized laboratories, advanced computational facilities, and office space. Replacements for those capabilities are needed for PNNL to continue to meet its program mission objectives in energy production, carbon sequestration, national security, and environmental management.

Proposed Action. The DOE Office of Science proposes to construct and operate the PSF using funding provided by DOE-SC, the DOE National Nuclear Security Administration, and the Department of Homeland Security. The PSF construction site consists of approximately 20 hectares (50 acres) within a vacant 38-hectare (103-acre) parcel of land, located north of the Richland, Washington, city limits. The property is bounded by Stevens Drive on the west, Horn Rapids Road on the south, and George Washington Way to the north and east. DOE also plans to maintain additional property to the north and east of the proposed construction site as a buffer area for the facilities. If DOE eventually requires restriction of public access to the entire buffer area, it may be necessary to close George Washington Way north of Horn Rapids Road, as well as the bike path that runs parallel to George Washington Way north of Horn Rapids Road. The combined construction site and buffer area would include about 130 hectares (320 acres), extending from Stevens Drive on the west to the Columbia River on the east, and from Horn Rapids Road on the south to a line running east-west approximately 1,100 meters (3,500 feet) north of Horn Rapids Road.

The PSF is planned as a modular facility to be constructed in two or more phases over a period of up to 20 years. The facility would house a number of research capabilities that utilize radiological materials, including materials science and technology, radiation detection, ultra trace detection technology, subsurface science, certification and dosimetry, shielded operations, and chemistry and processing. Additional support functions, such as a central utility plant, maintenance and fabrication support, and a waste management area may be constructed within, or adjacent to, the PSF. If all of the technical capabilities are ultimately relocated, the PSF could occupy approximately 31,000 square meters (332,000 square feet) and house about 480 scientific and support staff. A paved surface area, designated a "Radiation Detection Track," for experimental capabilities to detect radiological materials in vehicles and containers is also planned as part of the proposed action. Construction of the initial phase is planned to begin in late 2007 or early 2008, with initial occupancy and startup of portions of the facility scheduled for late 2010 or early 2011.

Phased Approach. The initial phase of PSF construction would consist of up to 22,000 square meters (240,000 square feet) and would accommodate the Ultra-trace, Radiation Detection, and Materials Science and Technology research capabilities. Additional support structures, including the central utility plant and the Radiation Detection Track, would be constructed to enable facility operations and support research missions. During the initial phase, several serviceable buildings in the Hanford Site 300 Area would be retained by PNNL and could remain in use for up to 20 years, or until any subsequent construction phases are scheduled and funded.

Later follow-on phases may include expansion of the PSF to incorporate modules for the Shielded Operations, Chemistry and Processing, Subsurface Science, and Certification and Dosimetry capabilities that are currently expected to remain in the retained 300 Area facilities. Although these proposed follow-on modules are not currently scheduled or funded for construction, they were evaluated in the EA to provide a bounding analysis of environmental impacts, and to maintain flexibility in long-term planning. Therefore, the environmental impacts of constructing and operating the PSF were based on the larger facility as described in the proposed action. That facility would accommodate all of these PNNL capabilities, whether they are relocated in the near term or over a longer period in a phased approach.

Affected Environment. The affected environment for the proposed action consists of the construction site north of Horn Rapids Road and the surrounding region. The proposed PSF construction site is on a relatively level parcel of vacant property, much of which has been previously disturbed. The site is located in Benton County and is within the City of Richland urban growth area. Land use has been designated as a mix of Business/Research Park (similar to the adjacent PNNL facilities), Commercial, and Low Density Residential. The existing PNNL facilities and the DOE Hanford Site, as well as a mix of light industrial, agricultural, business, school, and residential areas, are located in the vicinity of the proposed construction site. According to the 2000 Census, the population residing within 80 kilometers (50 miles) of the site was about 349,000, and the region contained some concentrations of minority and low-income populations. No prime farm land, scarce geological resources, surface water bodies, floodplains, or wetlands are within the proposed construction site. Biological resources at the site consist of a mix of desert-adapted shrubs and grasses as well as a variety of mammals and birds that inhabit those environments. During recent biological surveys, no federal or state threatened or endangered species, species proposed for listing, or critical habitats were observed. Cultural and historic resources have been identified within some portions of the proposed construction site and the buffer area, and appropriate measures for their management have been established. Investigation of potential hazardous materials at the site did not identify any contaminants present in surface soil or groundwater that would require remedial action.

Environmental Impacts of Proposed Action. Construction of the proposed PSF would be compatible with existing land-use designations established by DOE, Benton County, and the City of Richland, and environmental impacts associated with construction are expected to be similar to those for any commercial facility of comparable size. Temporary impacts on air quality would be anticipated, but would be within regulatory standards for criteria pollutants and particulates. Construction activities may likewise have short-term impacts on local traffic and noise levels. Resources required for construction consist of commonly available materials and fuels that are not unique or in short supply, and the labor required represents a small fraction of the local market. The proposed PSF construction site is not known to contain sensitive biological resources or critical habitats that would be affected by construction. Management of known cultural and historic resources, as well as any discovered during the construction process, would be in accordance with regulatory requirements and agreements among DOE and other responsible agencies or parties. Effluents and wastes generated during construction would be minimized to the extent practicable and would be managed using existing facilities. Health and safety risks to workers and members of the public from construction activities are projected to be small.

Because operations at the proposed PSF would consist of activities to be relocated from laboratories in the nearby 300 Area, the environmental impacts associated with operation of the facility are expected to be similar to, or lower than, those from the existing facilities. Routine radiological, chemical, and other operational effluents are not expected to result in human health impacts. The anticipated PSF inventories of radiological and other hazardous materials are lower than those in existing facilities and would not present a substantial safety risk to workers or members of the public. The generation of radioactive and hazardous wastes would be similar to, or lower than, current rates, and they would be accommodated using current waste management practices. The workforce would remain at about current levels, resulting in little, if any, incremental impact on community infrastructure, socioeconomic, or transportation resources. Because the impacts from facility operations are projected to be small in all cases, there would be no opportunity for both high and disproportionate adverse impacts on minority or low-income populations, nor would noticeable cumulative impacts with other ongoing operations in the region be expected.

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CONTENTS

FIGURES

TABLES

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Glossary

Acronyms and Abbreviations

ac	acre(s)
ac-ft	acre-feet
ALARA	As Low As Reasonably Achievable
ASIL	Acceptable Source Impact Level
Btu	British thermal unit
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curie(s)
cm	centimeter(s)
dBA	A-weighted decibel(s)
DHS	U.S. Department of Homeland Security
DHUD	U.S. Department of Housing and Urban Development
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-PNSO	U.S. Department of Energy, Pacific Northwest Site Office
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOE-SC	U.S. Department of Energy, Office of Science
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EMSL	(William R. Wiley) Environmental Molecular Sciences Laboratory
EPA	U.S. Environmental Protection Agency
EPHA	Emergency Preparedness Hazards Assessment
FMEF	Fuels and Materials Examination Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	foot/feet
ft^2	square feet
ft^3	cubic feet
g	gram(s)
gal	gallon(s)
gpd	gallons per day
gpm	gallons per minute
gsf	gross square feet

H-3	tritium
H-3E	tritium equivalent
HEPA	High Efficiency Particulate Air (filter)
ha	hectare(s)
in.	inch(es)
ISC	(EPA) Industrial Source Complex (model)
ISCORS	Interagency Steering Committee on Radiation Standards
km	kilometer(s)
L	liter(s)
LA	Limited Area
LCF	latent cancer fatality
LEED™	Leadership in Energy and Environmental Design
LIGO	Laser Interferometer Gravitational-Wave Observatory
L/m	liters per minute
LLW	low-level (radioactive) waste
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
MEI	maximally exposed individual
mi	mile(s)
mi^2	square mile(s)
MLLW	mixed low-level (radioactive and hazardous) waste
mrem	millirem
MW	megawatt(s)
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NIH	National Institutes of Health
NNSA	(DOE) National Nuclear Security Administration
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
Pa	Pascals
PNNL	Pacific Northwest National Laboratory
PNSO	(DOE) Pacific Northwest Site Office
POTW	Publicly Owned Treatment Works
PPA	Property Protection Area
ppm	parts per million
PSF	Physical Sciences Facility
psia	pounds per square inch, absolute
Pu-239	plutonium-239
Pu-239E	plutonium-239 equivalent

R&D	Research and Development
RCRA	Resource Conservation and Recovery Act of 1976
ROD	Record of Decision
RPL	Radiochemical Processing Laboratory
SHPO	State Historic Preservation Officer
SOx	Sulfur Oxides
TEDE	Total Effective Dose Equivalent
tpy	tons per year
TWRS	Tank Waste Remediation System
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSU	Washington State University
yd^3	cubic yard(s)

Definition of Terms

As Low as Reasonably Achievable (ALARA). An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process for minimizing doses to as far below regulatory limits as is practicable.

Background radiation. Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices).

Buffer Area. DOE-owned property to the north and east of the current PNNL Site that would be assigned to DOE-SC as a restricted access area around the proposed Physical Sciences Facility (PSF). The portion of the expanded PNNL Site north of Horn Rapids Road, including the buffer area, would extend from Stevens Drive on the west to the Columbia River on the east, and from Horn Rapids Road on the south to a line approximately 1100 m (3500 ft) north of Horn Rapids Road.

Collective dose. The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem.

Construction site (proposed PSF construction site). A portion of the current PNNL Site that would be occupied by the proposed PSF. The construction site is located within the portion of the PNNL Site north of Horn Rapids Road between Stevens Drive and George Washington Way (also known as the Horn Rapids Triangle).

Corrosive. A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

curie (Ci). A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

Fissionable material. A radionuclide capable of sustaining a neutron-induced chain reaction (e.g., uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, neptunium-237, americium-241, and curium-244).

Flammable gas. A gas that is flammable in a mixture of 13% or less (by volume) with air, or the flammable range with air is wider than 12% regardless of the lower limit, at atmospheric temperature and pressure.

Flammable liquid. A liquid having a flashpoint below 37.8°C (100°F) and having a vapor pressure not exceeding 276 kPa (40 psia) at 37.8°C (100°F) is known as a Class I flammable liquid. Class I flammable liquids are further divided into sub-classes depending on the boiling point and flash point.

Flammable solid. A solid substance, other than one that is defined as a blasting agent or explosive, that is liable to cause fire through friction or as a result of retained heat from manufacture, which has an ignition temperature below 100°C (212°F), or which burns so vigorously or persistently when ignited that it creates a serious hazard. Flammable solids include finely divided solid materials which, when dispersed in air as a cloud, could be ignited and cause an explosion.

Hazardous chemical. Any chemical that is a physical or health hazard.

Physical hazard – any chemical for which there is scientifically valid evidence that it is a

- flammable or combustible liquid
- compressed gas
- explosive
- flammable solid
- oxidizer
- peroxide
- pyrophoric
- unstable (reactive) or water-reactive substance.

Health hazard – any material for which there is statistically significant evidence that acute or chronic health effects may occur in exposed individuals. Such materials include

- carcinogens
- mutagens
- teratogens
- toxic or acutely toxic agents
- reproductive or developmental toxins
- irritants
- corrosives
- sensitizers
- liver, kidney, and nervous system toxins
- agents that act on the blood-forming systems
- agents that damage the lungs, skin, eyes, or mucous membranes.

Hazardous waste. Waste that contains chemically hazardous constituents regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended (40 CFR 261) and regulated as a hazardous waste and/or mixed waste by the EPA.

Highly toxic. To be classified as "highly toxic," a chemical must meet the following criteria: oral LD-50 in white rats equal to or less than 50 mg/kg; dermal LD-50 in white rabbits equal to or less than 200 mg/kg; or inhalation LC-50 in white rats equal to or less than 200 ppm (for gases or vapors) or 2 mg/L (for dusts, fumes, or mists).

Horn Rapids Triangle. A 38-ha (103-ac) parcel of vacant DOE-owned property in Benton County, Washington, bounded by Horn Rapids Road on the south, Stevens Drive on the west, and George Washington Way to the north and east. This property was assigned to the DOE Office of Science in 2004 and is part of the current PNNL Site. Construction of the proposed PSF would occur within this property, which is referred to throughout this document as the "(proposed PSF) construction site."

Latent cancer fatality (LCF). Death from cancer as a result of, and occurring some time after, exposure to ionizing radiation or other carcinogens.

Limited Area (LA). Security area designated for the protection of classified matter and certain types of special nuclear material.

Low-level (radioactive) waste (LLW). Radioactive waste that is not high-level waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in section 11e[2] of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material.

Maximally exposed individual. A hypothetical member of the public residing near the PNNL Site who, by virtue of location and living habits, could receive the highest possible radiation dose from radioactive effluents released from the PNNL Site.

millirem. A unit of radiation dose equivalent that is equal to 1/1,000 of a rem.

Mixed low-level waste (MLLW). Low-level waste determined to contain both source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954, as amended, and a hazardous component subject to the Resource Conservation and Recovery Act (RCRA), as amended, or Washington State Dangerous Waste Regulations.

module. A structural component of the PSF, housing one of the PNNL technical capabilities that would be relocated from the Hanford 300 Area facilities scheduled for closure. Each of the PSF modules may be constructed either as a separate facility, or as a segregated portion within a larger facility consisting of two or more modules and their associated support functions.

Nuclear Hazard Category. DOE Hazard Categories for nuclear facilities are defined in DOE-STD-1027-92 (DOE 1997). Nuclear facilities are further designated as Nuclear Hazard Category 1, 2, or 3, depending on the level of risk associated with facility operations and the quantities of radioactive materials in the facility. Table A.1 in Attachment 1 of the standard specifies the threshold quantities of radioactive materials for Nuclear Hazard Category 2 and 3 facilities.

- **Nuclear Hazard Category 1** facilities include those where the hazard analysis indicates the potential for significant offsite consequences. Those facilities typically include larger reactors (designated as Category A reactors, or those that operate at a steady-state thermal power greater than 20 MW) and other facilities identified by DOE as having the potential for more severe accidents.

- **Nuclear Hazard Category 2** facilities include those where the hazard analysis indicates the potential for significant onsite consequences from accidents (including the potential for criticality) or other events, and which require onsite emergency planning.

- **Nuclear Hazard Category 3** facilities include those where the hazard analysis indicates the potential for only significant localized consequences. Hazard Category 3 nuclear facilities contain quantities of hazardous radioactive materials that meet or exceed Hazard Category 3 threshold values as identified in DOE-STD-1027, Table A.1, but are less than Hazard Category 2 threshold values.

The maximum inventories for Category 3 facilities were established to exclude facilities that would be likely to have a significant radiological impact outside the facility.

Note: Radiological facilities include those containing quantities of radioactive materials that do not meet or exceed the thresholds defined for Category 3 facilities in DOE-STD-1027. Radiological facilities are associated with the lowest risks to workers or members of the public and typically house activities involving small quantities of dispersible radioactive materials.

Oxidizer. A chemical that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Person-rem. A unit of collective or population dose that is based on the sum of the total effective dose equivalent values for all individuals in a specified population.

Physical Sciences Facility. A modular complex of one or more buildings on the PNNL Site that would provide office space as well as laboratories for the following technical capabilities: Shielded Operations, Ultra-Trace, Radiation Detection, Chemistry and Processing, Materials Science and Technology, Subsurface Science, and Certification and Dosimetry. The PSF may also include space for support functions such as waste management, central utilities, maintenance, and fabrication.

PM_{10}. Particles having an aerodynamic diameter less than or equal to a nominal 10 micrometers.

$PM_{2.5}$. Particles having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

PNNL Site. DOE-owned property within Benton County and the City of Richland, Washington, assigned to the U.S. Department of Energy Office of Science. The PNNL Site currently consists of property occupied by the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) south of Horn Rapids Road, as well as vacant property north of Horn Rapids Road between Stevens Drive and George Washington Way (also known as the Horn Rapids Triangle). As discussed in this document, DOE is in the process of reassigning additional DOE property to the north and east of the current PNNL Site to PNSO. The expanded PNNL Site north of Horn Rapids Road would extend from Stevens Drive on the west to the Columbia River on the east, and from Horn Rapids Road on the south to a line approximately 1,100 m (3,500 ft) north of Horn Rapids Road.

Pollution Prevention. The use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and waste into land, water, and air. For the Department of Energy, this includes recycling activities.

Property Protection Area (PPA). Access-controlled facilities established to protect government-owned property against damage, destruction, or theft.

Pyrophoric. Materials that spontaneously ignite in air at or below a temperature of 54.5°C (130°F).

rem. A unit of radiation total effective dose equivalent (TEDE) based on the potential for impact on human cells.

Risk. The product of the probability of occurrence of an event or activity and the consequences resulting from that event or activity. For example, an accident that is expected to occur once in 100 years and result in a 1 in 1,000 probability of latent cancer fatality (LCF) in the affected population would be associated with a risk of $(0.01\ y^{-1}) \times (0.001\ LCF) = 0.00001\ LCF/y$, or a risk of LCF equal to 1 in 100,000 per year of operation.

Total effective dose equivalent (TEDE). The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). TEDE is expressed in units of rem.

Toxic. To be classified as "toxic," a chemical must meet the following criteria: oral LD-50 in white rats greater than 50 mg/kg but less than 500 mg/kg; dermal LD-50 in white rabbits greater than 200 mg/kg but less than 1,000 mg/kg; or inhalation LC-50 in white rats greater than 200 ppm but less than 2,000 ppm (for gases or vapors) or greater than 2 mg/L but less than 20 mg/L (for dusts, fumes, or mists). Chemicals that have a higher LD-50 or LC-50 are considered to be nontoxic for the purposes of monitoring.

Toxic air pollutant. Any State of Washington Class A or Class B toxic air pollutant listed in WAC 173-460-150 and 173-460-160. The term "toxic air pollutant" may include particulate matter and volatile organic compounds if an individual substance or a group of substances within either of these classes is listed in WAC 173-460-150 and/or 173-460-160. The term "toxic air pollutant" does not include particulate matter and volatile organic compounds as generic classes of compounds.

Transuranic waste. Radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for the following:

- high-level radioactive waste
- waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations
- waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.

Unstable/Reactive. A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

Water Reactive. A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Metric Conversion Chart

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	Millimeters	Millimeters	0.03937	inches
inches	2.54	Centimeters	Centimeters	0.393701	inches
feet	0.3048	Meters	Meters	3.28084	feet
yards	0.9144	Meters	Meters	1.0936	yards
miles (statute)	1.60934	Kilometers	Kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	Hectares	Hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir.)	28.34952	Grams	Grams	0.035274	ounces (avoir.)
pounds (avoir.)	0.45359237	Kilograms	Kilograms	2.204623	pounds (avoir.)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	Milliliters	Milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	Liters	Liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	Liters	Liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	Kilopascals	Kilopascals	0.14504	pounds per square inch
torr	133.32	Pascals	Pascals	0.0075	torr

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE, Third Ed., 1993, Professional Publications, Inc., Belmont, California.

Scientific Notation Conversion Chart

Numbers that are very small or very large are often expressed in scientific or exponential notation as a matter of convenience. For example, the number 0.000034 may be expressed as 3.4×10^{-5} or 3.4E-05, and 65,000 may be expressed as 6.5×10^{4} or 6.5E+04. In this document, numerical values less than 0.001 or greater than 9999 are generally expressed in exponential notation, or 1.0E-03 and 9.9E+03, respectively.

Multiples or sub-multiples of the basic units are also used. A partial list of prefixes that denote multiples and sub-multiples follows, with the equivalent multiplier values expressed in scientific and exponential notation:

Name	Symbol	Value Multiplied by:		
pico	p	0.000000000001	or 1×10^{-12}	or 1E-12
nano	n	0.000000001	or 1×10^{-9}	or 1E-09
micro	μ	0.000001	or 1×10^{-6}	or 1E-06
milli	m	0.001	or 1×10^{-3}	or 1E-03
centi	c	0.01	or 1×10^{-2}	or 1E-02
deci	d	0.1	or 1×10^{-1}	or 1E-01
--	--	1	or 1×10^{0}	or 1E+00
deka	Da	10	or 1×10^{1}	or 1E+01
hecto	H	100	or 1×10^{2}	or 1E+02
kilo	K	1,000	or 1×10^{3}	or 1E+03
mega	M	1,000,000	or 1×10^{6}	or 1E+06
giga	G	1,000,000,000	or 1×10^{9}	or 1E+09
tera	T	1,000,000,000,000	or 1×10^{12}	or 1E+12

The following symbols are occasionally used in conjunction with numerical expressions.

Symbol	Indicates the preceding value is:
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to

In some cases, numerical values in this document have been rounded to an appropriate number of significant figures to reflect the accuracy of data being presented. For example, the numbers 0.021, 21, 2,100, and 2,100,000 all contain 2 significant figures. In some cases, where several values are summed to obtain a total, the rounded total may not exactly equal the sum of its rounded component values.

1.0 Introduction and Background

This Environmental Assessment (EA) provides information and analysis of proposed U.S. Department of Energy (DOE) activities associated with constructing and operating a new Physical Sciences Facility (PSF) in Benton County, north of Richland, Washington. The proposed PSF would replace a number of existing research laboratories in the Hanford Site 300 Area that are currently occupied by Pacific Northwest National Laboratory (PNNL) and that are scheduled for closure under the DOE River Corridor Closure Project. Several serviceable buildings in the Hanford Site 300 Area will be retained and used by PNNL until replacement facility construction phases are scheduled and budgeted.

Information contained in this EA will be used by the DOE Office of Science (DOE-SC) to determine if the proposed action is a major federal action significantly affecting the quality of the human environment. If the proposed action is determined to be a major action with potentially significant environmental impacts, an Environmental Impact Statement (EIS) would be required. If the proposed action is not determined to be a major action that could result in significant environmental impacts, a Finding of No Significant Impact (FONSI) will be issued, and the action may proceed. This EA is prepared in compliance with the *National Environmental Policy Act of 1969* (NEPA), as amended (42 USC 4321 *et seq.*); the *Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA* (Title 40, Code of Federal Regulations, Parts 1500–1508); and the DOE *National Environmental Policy Act Implementing Procedures* (Title 10, Code of Federal Regulations, Part 1021).

1.1 River Corridor Closure Project and Cleanup of the 300 Area

DOE has developed a cleanup strategy for the Hanford Site that includes activities necessary to restore the Columbia River Corridor (DOE-RL and DOE-ORP 2002). The DOE Richland Operations Office (DOE-RL) has primary responsibility for waste management operations in the 200 Areas on the Hanford Site Central Plateau, as well as cleanup of facilities along the Columbia River Corridor, including the former plutonium production reactors and selected 300 Area facilities. As part of the river corridor restoration, buildings in the Hanford Site 300 Area are scheduled to be decontaminated and demolished. Cleanup activities are currently underway as part of the DOE River Corridor Closure Project, and this work is planned to be largely completed by 2012.

1.2 DOE Office of Science and PNNL Research Activities in the 300 Area

DOE-SC promotes discoveries and development of scientific tools that transform the understanding of energy and matter and advance the national, economic, and energy security of the United States. DOE-SC is the single largest supporter of basic research in the physical sciences in the United States, providing more than 40% of total funding for this area of national importance. It oversees, and is the principal federal funding agency of, the nation’s research programs in materials and chemical sciences, high-energy physics, nuclear physics, and fusion energy sciences. DOE-SC also manages fundamental research programs in basic energy sciences, environmental and life sciences, computational science, climate change, geophysics, genomics, and science education.

DOE-SC accomplishes this mission through investments in the nation's scientific enterprise, including 10 national laboratories. The proposed action as described in this EA directly supports DOE-SC activities and would provide infrastructure, scientific tools, and technical staff to address DOE and other federal agency science and technology needs.

PNNL is a DOE-SC multi-program national laboratory, providing scientific research capabilities and advanced scientific knowledge to support DOE and national strategic goals. Primary clients for PNNL capabilities include DOE-SC and other DOE organizations, the National Nuclear Security Administration (NNSA), the U.S. Department of Homeland Security (DHS), the National Institutes of Health (NIH), the U.S. Department of Defense (DoD), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA).

PNNL staff, including those in the 300 Area, support the nation's strategic goals with research and development (R&D) capabilities in science, national security, energy, and environment. In *science*, PNNL conducts research in biological and environmental sciences and maintains programs in chemistry, chemical physics, materials science, nuclear science and technology, and computer and information science. For *national security*, PNNL provides nuclear science and technology and information analytics capabilities to help prevent the proliferation of weapons of mass destruction, to maintain compliance with international arms control treaties, and to protect the nation's critical infrastructure. For *energy*, PNNL provides the materials sciences and chemical sciences capabilities to develop technology for the energy systems of the future; and for *environment*, PNNL provides science and technology for understanding complex environmental systems and cleanup of contaminated sites. These PNNL capabilities contribute to solving some of the nation's pressing problems in a number of areas, including energy production, carbon sequestration, national security, and environmental management in support of cleanup.

2.0 Purpose and Need for Agency Action

To meet long-term DOE and other federal agency (NNSA, DHS) mission needs, DOE needs to provide replacement laboratory space and associated infrastructure for some PNNL R&D activities currently located in 300-Area facilities that are scheduled to be removed in support of accelerated cleanup.

To accomplish its mission of scientific research, PNNL requires a variety of facilities and equipment, including radiological and other specialized laboratories, advanced computational facilities, and office space. As of mid-2006, approximately 4,200 PNNL staff members supported research activities in 79 buildings occupying nearly 190,000 m^2 (2,000,000 ft^2) in north Richland and other locations. About one-third of that space, or 60,000 m^2 (650,000 ft^2), is located in selected 300 Area facilities targeted by the DOE River Corridor Closure Project for removal. Those facilities represent about 45% of PNNL's general laboratory space, nearly all of its shielded radiological laboratory space, and other unique capabilities. Replacements for those capabilities are needed for PNNL to continue to meet its program mission objectives, as defined by DOE, in energy production, carbon sequestration, national security, and environmental management. Figure 2.1 shows the location of PNNL relative to the Hanford Site 300 Area, the Hanford Reach National Monument, and north Richland.

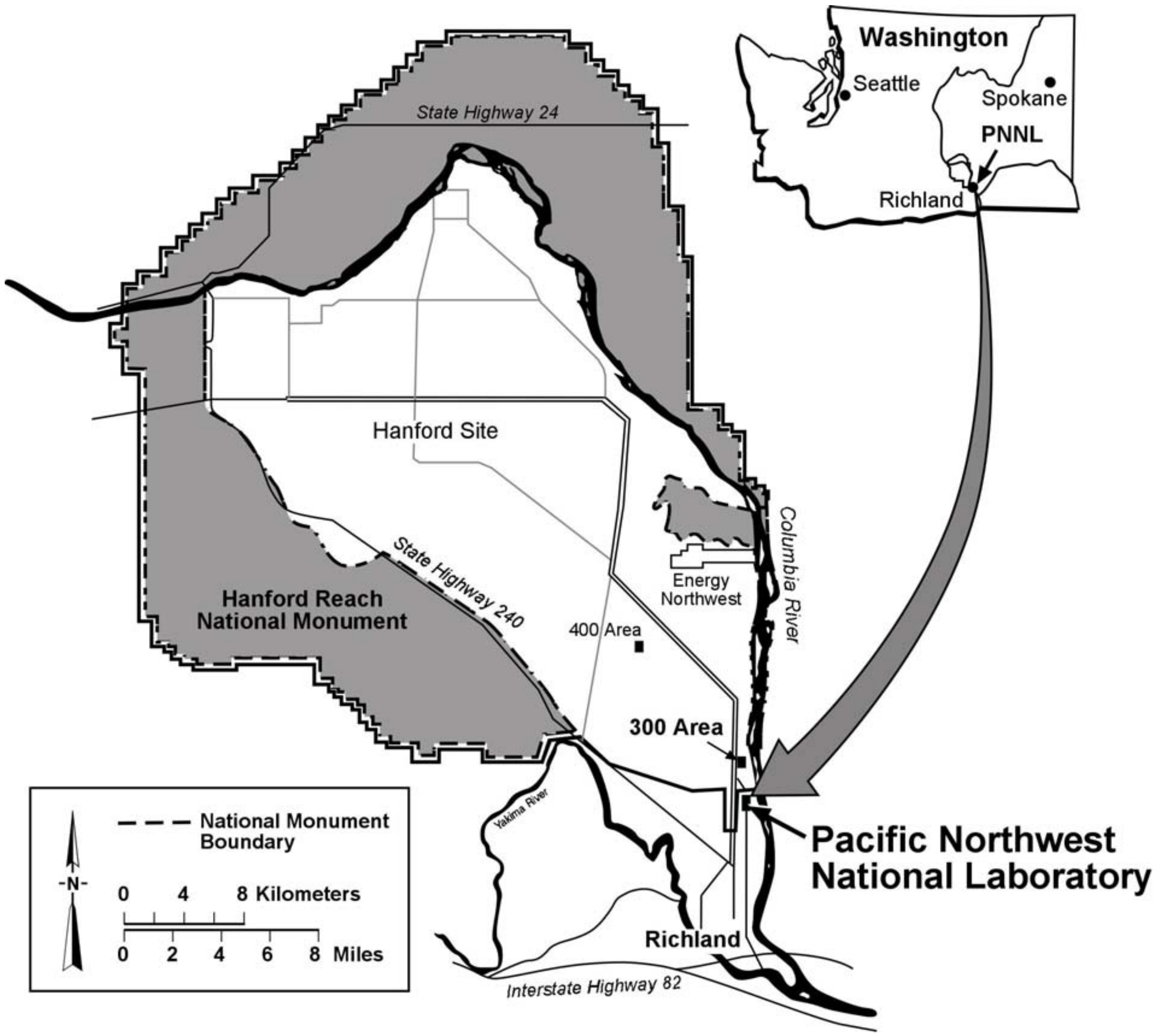

Figure 2.1. Location of PNNL Relative to the Hanford Site 300 Area, the Hanford Reach National Monument, and North Richland

3.0 Description of the Proposed Action and Alternatives

This section describes the DOE-SC proposed action and alternatives to the proposed action, including the No-Action Alternative. It should be noted that facility design and construction details described for the proposed action are based on conceptual plans. The final design and schedule as ultimately approved for construction may differ from that discussed within this EA. However, the nature, scope, and environmental impacts of the proposed action described in this document are expected to substantially reflect and bound those associated with actual construction and operation of the facility.

3.1 Proposed Action

DOE-SC proposes to construct and operate the PSF within the PNNL Site, directly north of existing PNNL facilities. Funding would be jointly provided by DOE-SC, the NNSA, and DHS. The proposed facility would provide replacement laboratories and infrastructure to continue mission-critical research capabilities, including space for laboratories, shielded radiological operations, semi-clean rooms, offices, and support and storage areas. The PSF could provide office space, laboratories, and support services for technical capabilities that currently occupy facilities in the 300 Area. These research capabilities all utilize radiological materials, and locating them in close proximity to each other could facilitate use of common resources and simplify radiological material control. Additional support functions, for example, a central utility plant, maintenance and fabrication support, and a waste management area, may be constructed within, or adjacent to, the PSF. The PSF is planned as a modular complex that could occupy a total of approximately 31,000 m^2 (332,000 gsf[(1)]), to be constructed in a phased manner over a period of up to 20 years. In addition, a paved surface area, designated a "Radiation Detection Track," for experimental capabilities to detect radiological materials in vehicles and containers is planned as part of the proposed action. The PSF would house about 460 research staff, and an overall total of about 480 scientific and support staff would occupy the proposed facility. Construction of the PSF is planned to begin in late 2007 or early 2008, with initial occupancy and startup of portions of the facility scheduled for late 2010 or early 2011.

The proposed PSF would be constructed on approximately 20-ha (50-ac) within the PNNL Site, north of the Richland, Washington, city limits and Horn Rapids Road. The construction site is within a 38-ha (103-ac) parcel of land (also known as the Horn Rapids Triangle) bounded by Stevens Drive on the west, Horn Rapids Road on the south, and George Washington Way to the north and east. The property is owned by DOE and was reassigned in 2004 from the DOE Office of Environmental Management Hanford Site, to DOE-SC, which oversees PNNL operations through its Pacific Northwest Site Office (PNSO).

In addition, DOE-RL is in the process of reassigning property to the north and east of the current PNNL Site to DOE-SC. That area would serve as a restricted access buffer for the proposed facilities. No construction is currently planned for the buffer area, other than installation and maintenance of fencing at the boundary as necessary to control public access. The roads within the buffer area that connect George Washington Way to Stevens Drive and to the 300 Area, as well as the bike path north of Horn Rapids

(1) Gross square footage includes all the building space, including wall thickness, hallways, and all other common space.

Road, could also be closed to public access. The haul road that crosses the buffer area between the Port of Benton barge facility and Stevens Drive would continue to operate as needed. In addition to the area south of Horn Rapids Road that houses the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), the expanded PNNL Site north of Horn Rapids Road would include approximately 130 ha (320 ac), extending from Stevens Drive on the west to the Columbia River on the east, and from Horn Rapids Road on the south to a line running east-west approximately 1,100 m (3,500 ft) north of Horn Rapids Road. The property north of Horn Rapids Road is located in Benton County, and it is being considered for annexation to the City of Richland as part of the city's urban growth area. Figure 3.1 shows the existing PNNL facilities and the location of the proposed PSF construction site.

Phased Approach. DOE proposes to construct the PSF in phases over a period of up to 20 years, as required to support research capabilities displaced by remediation of the 300 Area, and depending on availability of funding. The initial phase of PSF construction would consist of up to 22,000 square meters (240,000 square feet) and would accommodate the Ultra-trace, Radiation Detection, and Materials Science and Technology research capabilities. The initial phase is scheduled to be completed by late 2010 or early 2011.

Later phases may include expansion of the PSF to incorporate modules for the Shielded Operations, Chemistry and Processing, Subsurface Science, and Certification and Dosimetry capabilities. These capabilities could remain in existing 300 Area facilities for up to 20 years, and they would be relocated if DOE decides to construct additional PSF modules in the future. Although these modules are not currently scheduled or funded for construction, they are included in this EA to provide a bounding analysis of environmental impacts, and to maintain flexibility in long-term planning. Therefore, the environmental impacts of constructing and operating the PSF are based on the larger facility as described in the previous section and as shown in Figure 3.2. That facility would accommodate all of these PNNL capabilities, whether they are relocated in the near term or over a longer period in a phased approach. Following the initial phase, and prior to construction of additional modules, DOE would evaluate the NEPA documentation to confirm that the environmental review is still applicable, and if necessary, conduct a supplemental review.

DOE Nuclear Hazard Categories

DOE Hazard Category 1, 2, and 3 facilities, as defined in DOE-STD-1027 (DOE 1997), are normally referred to as "nuclear facilities."

Hazard Category 1 facilities consist of those assigned the highest relative hazard levels, such as larger nuclear reactors. Category 1 facilities are associated with potential accidents that could produce significant consequences beyond the site boundary.

Hazard Category 2 facilities may involve work with significant quantities of dispersible radioactive materials. Category 2 facilities are associated with potential accidents that could produce significant consequences only within the site boundary.

Hazard Category 3 facilities involve work with smaller quantities of dispersible radioactive materials relative to those associated with Hazard Category 2 facilities. Category 3 facilities are associated with potential accidents that could only produce significant localized consequences.

Radiological facilities contain less than Hazard Category 3 quantities of radioactive materials. Radiological facilities typically house activities involving small quantities of dispersible radiological materials.

Physical Sciences Facility

The PSF is planned as a modular facility, with discrete space for each of the PNNL technical capabilities that would be relocated from the 300 Area. The Shielded Operations module, which may be constructed in a later phase, would be operated as a DOE Nuclear Hazard Category 3 facility, and the other modules would be managed as radiological facilities (see accompanying text box). The PSF would incorporate features that meet Leadership in Energy and Environmental Design (LEED™) certification requirements to reduce environmental impacts associated with construction and operation, provide a healthy work place, and promote energy efficiency.

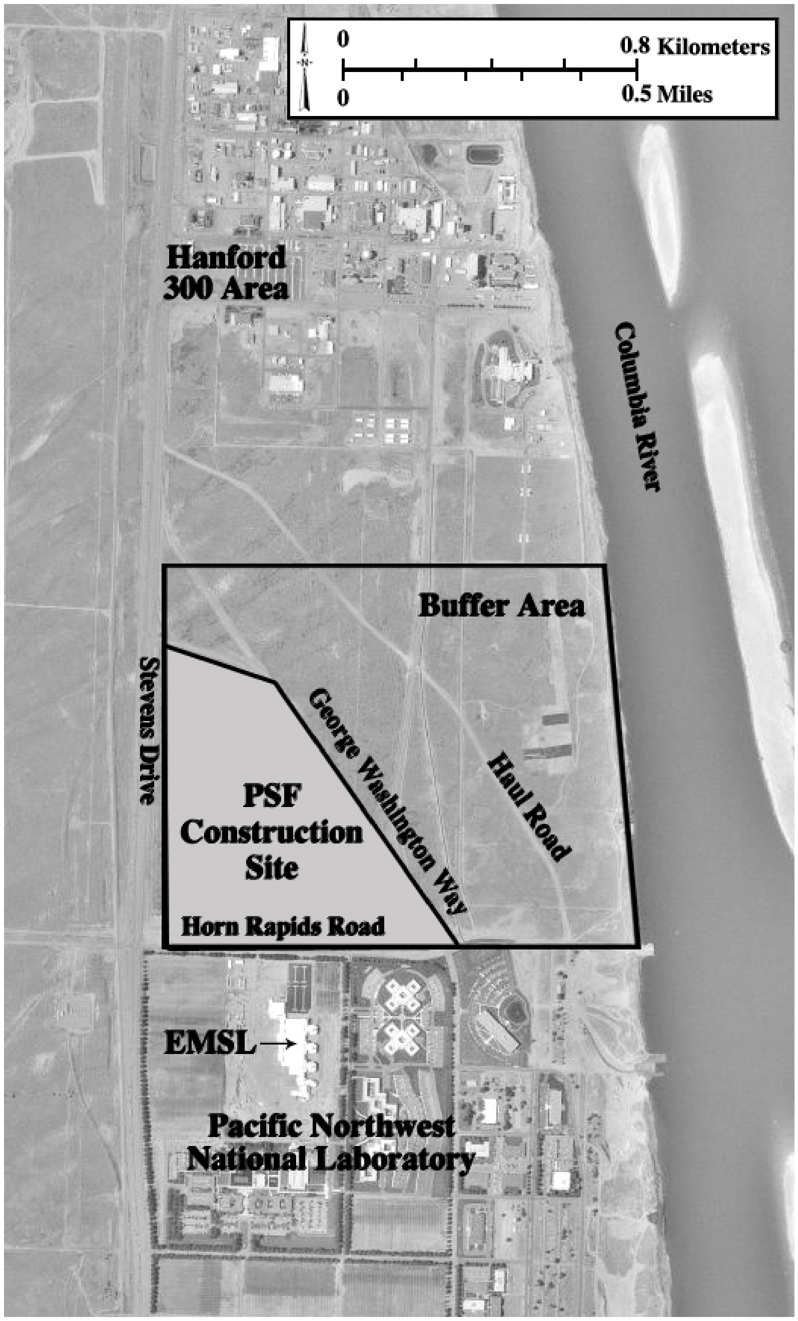

Figure 3.1. Aerial View of the Proposed PSF Construction Site, Buffer Area, and Existing PNNL Facilities (Base photo courtesy of TerraServer and U.S. Geological Survey)

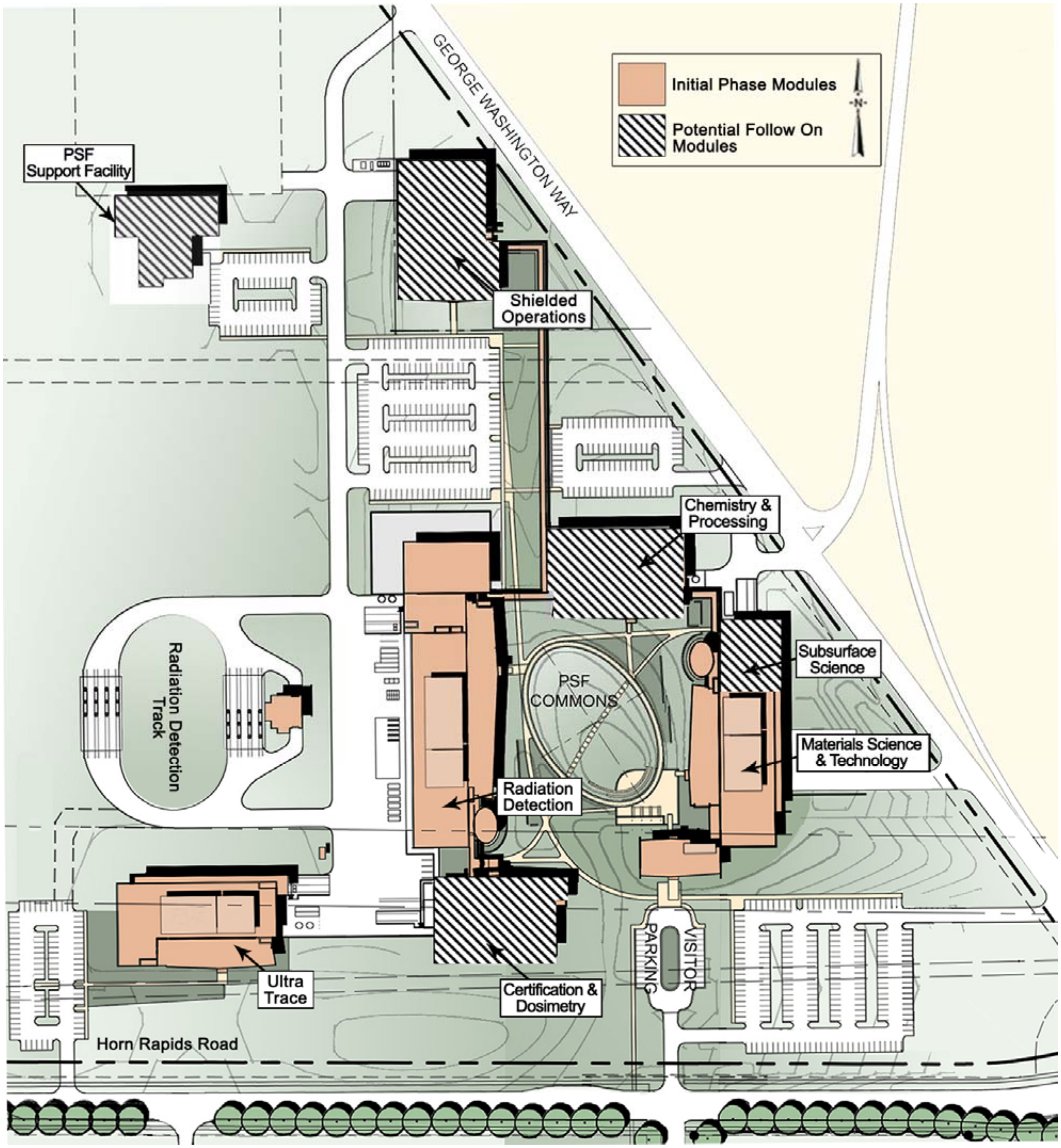

Figure 3.2. Conceptual Layout of the Proposed Physical Sciences Facility

The modular PSF layout would be designed to facilitate cooperation among the technical capabilities while establishing discrete work environments to meet specific program needs (Figure 3.2). As ultimately constructed, it may consist of one or more separate buildings, depending on safety and other operational requirements. For example, the Shielded Operations module is currently planned to be separate from the other modules because of facility safety considerations. The Ultra-trace module would also be isolated either physically or by operational controls to prevent the introduction of contamination from outside sources. For purposes of analysis in this EA, the environmental impacts of constructing and operating the PSF were based on gross square footage that would eventually be required to accommodate all of the relocated technical capabilities. However, the environmental impacts of constructing and operating the PSF are expected to be similar for any configuration that provides comparable space for those activities.

Initial-Phase Modules

Modules for the Ultra-trace, Radiation Detection, and Materials Science and Technology capabilities would be included in the initial phase of PSF construction. Activities and research programs associated with these capabilities are described in the following section.

The **Ultra-trace** module would provide a combination of specialized laboratories, instrumentation, and technical staff focused on developing and applying state-of-the-art analytical methodology in support of national needs, such as international treaty verification and related actions to prevent the proliferation of nuclear weapons, chemical weapons, and fissile materials. This capability includes highly sensitive analytical systems, such as mass spectrometers, optical microscopes, and electron microscopes, to detect trace quantities of ionic, inorganic, and organic constituents in complex physical and chemical matrices. This module is distinguished by the capacity to determine the composition and concentration of actinide isotopes at ultra-trace levels in environmental sample matrices, unique particle analysis techniques, and the capability to perform ultra-trace level (parts per trillion) analysis of organic compounds in complex environmental matrices.

Primary users of this capability are expected to include national security programs within DOE, NNSA, DoD, and DHS. Other government agencies and laboratories that utilize existing PNNL facilities would benefit as well, and the staff involved in these programs collaborate extensively with universities and international organizations as part of their research activities.

The **Radiation Detection** module would house capabilities for state-of-the-art analytical chemistry, radiation physics, light detection, particle detection, chromatography, scintillation materials development, sorbents, and nuclear forensics instrumentation. Applications for these capabilities range from fundamental science, such as neutrino mass detection, to applied systems for prevention of nuclear proliferation and radiation portal monitoring at U.S. borders. The Radiation Detection Track, a paved outdoor area that supports this capability, would contain experimental facilities to detect radiological materials (as sealed sources) in vehicles and shipping containers. That capability supports national security programs to help prevent illegal transport of these materials into this country as well as internationally. The radiation detection capabilities also support various national security programs for DHS, DoD, NNSA and other DOE organizations.

The **Materials Science and Technology** module would include laboratories for receipt and processing of radioactive material samples to evaluate their performance in high-radiation and high-temperature environments, in addition to capabilities for modeling materials behavior in these extreme environments. Research within this module would consist of studies to evaluate 1) the aging and degradation of materials in nuclear systems, 2) the development of radiation-resistant structural materials for advanced fission and fusion reactors, 3) stress-corrosion cracking in nuclear reactor environments, and 4) radiation-induced materials degradation. Those studies support DOE programs in basic energy sciences, nuclear energy, and fusion, as well as programs for NRC.

Follow-on Modules

Modules for the Shielded Operations, Chemistry and Processing, Subsurface Science, and Certification and Dosimetry capabilities would be included in follow-on phases of PSF construction, should DOE decide to complete them. These capabilities would remain in existing 300 Area facilities for a period of up to 20 years. Activities and research programs associated with these capabilities are described in the following section.

The **Shielded Operations** module would contain shielded hot cells, hoods, and glove boxes that provide the capability to work with Nuclear Hazard Category 3 quantities of dispersible radioactive materials. Consistent with DOE nuclear safety requirements (10 CFR 830, Subpart B; DOE 2005a), and commensurate with the operational risks, the facility would be constructed to incorporate engineered safety systems such as filters and effluent monitoring systems, as well as principles for keeping worker exposures to radioactive and hazardous materials "As Low As Reasonably Achievable" (ALARA). The Shielded Operations module would provide the capability for receipt and initial processing of a wide variety of radioactive liquids and solids, after which the processing of smaller quantities could be performed in radiological laboratories (for example, the Chemistry and Processing or Materials Science and Technology modules). This module would also support the preparation, modification, and repair of sealed radiation sources that are used for R&D work by other PNNL organizations.

Primary users of this capability are expected to include various DOE and NNSA programs related to fusion energy, tritium production, instrumentation for use in high-radiation environments, the production of medical isotopes, the analysis of spent nuclear fuel, and the management of specialized nuclear wastes. An assessment conducted in 2005 concluded that a Nuclear Hazard Category 3 facility would be sufficient to support projects utilizing the Shielded Operations module (DOE-PNSO 2005). Most of those projects would be relocated from the existing PNNL Radiochemical Processing Laboratory (RPL) in the 300 Area, which is a Nuclear Hazard Category 2 facility. The projects that would relocate from the RPL and other 300 Area laboratories are expected to require a smaller total inventory of radioactive materials than is currently present in the RPL; therefore, the Shielded Operations module could operate as a Nuclear Hazard Category 3 facility.

The **Chemistry and Processing** module would provide diverse capabilities for evaluating material surface and bulk properties. Radiochemical laboratories would be equipped with hoods, glove boxes, shielded facilities, and their support infrastructure. Instrumentation in the facility would include optical, electron, and atomic force microscopes; radiation counting equipment; nuclear magnetic resonance instruments for radioactive sample analysis; calorimeters; X-ray diffraction systems; and X-ray photoelectron, raman, optical, and mass spectrometers. These capabilities would enable fundamental research in radionuclide chemistry, particularly actinide chemistry, for DOE-SC, and they would also provide extensive support for the other laboratory modules. Additional programs expected to utilize this capability include DOE and NNSA programs in nuclear nonproliferation, nuclear energy, isotope production, and nuclear waste management.

The **Subsurface Science** module would support fundamental research on the mobility and degradation of compounds in the subsurface environment and on interactions of various waste forms with engineered materials and geologic environments. This research includes the evaluation of thermochemical properties of actinides and other trace elements and of mineral weathering, oxidation-reduction reactions, and related phenomena to obtain fundamental data to use in predicting the geochemical behavior of such elements in complex geologic systems. This research benefits DOE programs in environmental management, geochemistry of radioactive materials, and civilian nuclear waste management.

The **Certification and Dosimetry** module would provide capabilities to certify the performance of radiation detection instruments to American National Standards Institute requirements, including the evaluation of the mechanical, electrical, radiological, and environmental specifications of the instruments. The facility would also be accredited by the National Institute of Standards and Technology to perform gamma, beta, and neutron irradiations for performance testing of other accredited dosimeter processors in the United States. External dosimetry capabilities also support research in radiation measurement and medical physics. In addition, the laboratory would provide accredited external and internal dosimetry services and expertise to other PNNL and Hanford Site organizations, as well as numerous national and international agencies and commercial operations.

PSF Radiological and Chemical Inventory

The types and forms of radioactive and hazardous materials proposed for use in the PSF are expected to be similar to those presently in use at PNNL-occupied research laboratories located in the 300 Area. Although the types and forms of materials are expected to be similar, the total quantities of radioactive and hazardous materials are expected to be reduced in the PSF compared to those in use at existing 300 Area laboratories occupied by PNNL. Materials not relocated from the 300 Area would either be transferred to other PNNL or Hanford Site projects, or they would be disposed of as waste when the facilities are decommissioned during the 300 Area cleanup. Because the PSF is planned as a research facility to accommodate a variety of different activities, inventories of radiological and chemically hazardous materials may change, prior to occupancy and during operation, as the mix of programs and projects evolves. However, the environmental impact analyses in Section 5 of this EA are expected to bound activities conducted in the PSF. PNNL will be required to manage radioactive material inventories in the PSF modules to quantities lower than applicable radioactive material inventory limits, such as Nuclear Hazard Category thresholds, Air Permit limits, and Emergency Planning limits. Chemical inventory limits would be established for each laboratory facility or module on the basis of facility design and operational needs. These chemical limits are based, in part, on criteria provided in consensus standards, such as those of the National Fire Protection Association and the International Code Council for the design of facilities containing hazardous materials.

Radiological Materials. DOE standards for nuclear facilities define the maximum quantities of radioactive materials that may be present according to the nuclear hazard category assigned to each facility (DOE 1997). DOE Nuclear Hazard Category 3 facilities and radiological facilities are currently limited to specified maximum quantities of any radionuclide in dispersible form, as defined in the standard. The Shielded Operations module would be designed to accommodate the maximum allowable inventory for any radionuclide, or any combination of radionuclides for which the sum of fractions of the maximum Nuclear Hazard Category 3 inventories is less than 1. The other modules would each be designed to accommodate the maximum allowable radiological facility inventory for any radionuclide, or any combination of radionuclides for which the sum of fractions of the maximum radiological facility inventories is less than 1. However, operational restrictions on facility radionuclide inventories would be in place to ensure that dose consequences at the site boundary from hypothetical accidents remain within applicable guidelines and to provide a reasonable margin of flexibility for receipt and use of materials. Radionuclides that could be present in the PSF include a wide variety of radioactive isotopes such as tritium, fission products (such as strontium-90), and activation products (such as cobalt-60), as well as limited quantities of special nuclear materials (largely isotopes of uranium and plutonium) and transuranic radionuclides.

Table 3.1 contains a representative inventory of radioactive materials by module, normalized to plutonium-239 equivalent (Pu-239E) or tritium equivalent (H-3E) curies (Ci),[2] based on materials currently in use, or anticipated for use, by projects that may ultimately relocate to the PSF from 300 Area laboratories. Those inventories are not intended to represent the maximum quantities that may eventually be present in the facilities; however, operational controls based on facility safety requirements would ensure that radiological inventories in the facility remain below the applicable quantities listed in the DOE (1997) standard. For example, Nuclear Hazard Category 3 facilities are limited to less than 56 Ci of plutonium-239 (Pu-239) or less than 300,000 Ci of tritium (H-3); Radiological facilities are limited to less than 0.52 Ci Pu-239 or less than 16,000 Ci H-3. Because not all radiological materials currently existing in the 300 Area facilities would be relocated to the PSF, the Shielded Operations Module would operate as a DOE Nuclear Hazard Category 3 facility, and the other modules would be managed as radiological facilities.

Table 3.1 contains a listing of inventories for radiological materials in dispersible form separately from those in sealed sources. In some cases, the DOE (1997) standard permits facilities to exempt materials from the allowable inventories established for nuclear hazard classification purposes if the material is in a physical form, or is stored in a containment system, that meets specified standards. Radioactive materials in non-dispersible forms, materials contained within sealed sources, and materials stored in containers designed to prevent their release are not expected to contribute substantially to the risk associated with facility operations because their potential for release to the environment would be negligible under all but the most improbable accident conditions. Fissionable materials would be managed according to DOE (2005a) requirements related to criticality safety. However, the forms and quantities of fissionable materials permitted in the PSF would be managed to preclude the potential for criticality accidents.

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(2) Plutonium-239 equivalent (Pu-239E) is the activity in Ci of a given non-volatile isotope or combination of non-volatile radionuclides that would produce the same total effective dose equivalent as 1 Ci of Pu-239 if released to the environment under accident conditions. Tritium equivalent (H-3E) is the activity in Ci of a given volatile isotope or combination of volatile isotopes that would produce the same total effective dose equivalent as 1 Ci of H-3 if released to the environment under accident conditions. This method of normalizing dose equivalence is used in accident analyses to allow consequences to be evaluated in terms of a single radionuclide for each physical form. Use of the Pu-239 and H-3 equivalence in Table 3.1 also provides a perspective on the relative distribution of materials among the various PSF modules.

Table 3.1. Representative PSF Radioactive Material Inventory by Module (Inventory values in Ci Pu-239E or H-3E)

PSF Module	Sealed Source Pu-239E Ci	Dispersible Pu-239E Ci	Dispersible H-3E Ci
Shielded Operations	15	10.4	36,000
Chemistry and Processing	1.66E-03	0.0158	1.15E-03
Materials Science & Technology	0.0	0.0937	162
Subsurface Science	0.0	0.266	0.0161
Radiation Detection	70.9	0.388	3.33
Certification and Dosimetry	51.1	0.225	27.7
Ultra-trace	0.0	0.204	1.55
Total	**137**	**11.6**	**36,200**

Chemicals. A listing of hazardous chemical inventories has been prepared for DOE and other agency projects in 300 Area laboratories occupied by PNNL. The listing was limited to chemicals associated with current programs and projects that may transition to the PSF or which are consistent with the planned capability and mission of the PSF. The review identified a broad variety of chemicals that may be used in PSF laboratory operations, although typical quantities in use or present in an individual laboratory at any given time are anticipated to be relatively small based on current usage and laboratory practices. As noted previously, the types and quantities of chemicals present in the facility and their usage rates are expected to vary over time according to programmatic needs. However, the quantities of hazardous chemicals present in the PSF would be managed within applicable limits specified by the applicable International Building Code (for example, ICC 2006 or current standard).

As an indicator of hazardous chemical use by current PNNL programs that would relocate to the PSF, Table 3.2 contains a listing of the chemical inventory as of February 2006 by major hazard group, which is expected to be representative of the types of chemicals used in the PSF (see Glossary for definitions of hazardous chemical classes). There are some chemical hazard classifications that are not included in the inventory, which indicates there are no chemicals in those hazard classifications that are currently in use. However, if new projects were to introduce those types of materials, they would be managed and controlled in accordance with established processes for evaluating new work and managing chemical hazards within PNNL facilities and projects.

Support Functions

The PSF would also include support functions that are necessary to operate the laboratories and offices. These functions could either be constructed as part of the laboratory complex or as separate facilities. The maintenance and fabrication support function would potentially include fabrication shops; measurement laboratory; paint shop; welding shop; crane system; and secure, covered exterior equipment storage. The central utility plant would be located within or near the PSF. At this conceptual stage, the central utility plant is sized only to serve the PSF, although it may be designed to allow expansion to accommodate additional load from other PNNL buildings, should it be needed in the future. Space for temporary storage and management of radioactive and hazardous waste would also be provided within the complex. Management of radioactive and hazardous wastes would be in accordance with any permits required by regulation, as listed in Section 6, and would be subject to applicable radiological and hazardous material inventory limitations discussed in the previous section.

Table 3.2. Recent Hazardous Chemical Inventory for Capabilities and Programs that Would Be Relocated to the PSF(1)

Chemical Hazard Group	Estimated Inventory
Flammable	
Gases (e.g., hydrogen)	160 m^3 (5,690 ft^3)
Solids (e.g., sodium sulfide)	220 kg (490 lb)
Liquids (e.g., alcohols)	3,500 L (928 gal)
Liquefied Gas (e.g., propane)	1,060 L (280 gal)
Oxidizing	
Gases (e.g., oxygen)	120 m^3 (4,260 ft^3)
Solids (e.g., nitrates)	290 kg (1,320 lb)
Liquids (e.g., hydrogen peroxide)	8,600 L (2,260 gal)
Corrosive	
Gases (e.g., ammonia)	2.6 m^3 (91 ft^3)
Solids (e.g., silver nitrate)	850 kg (1,880 lb)
Liquids (e.g., acids)	2,160 L (570 gal)
Unstable (Reactive)	
Gases (e.g., acetylene)	9.6 m^3 (340 ft^3)
Solids (e.g., calcium hypochlorite)	68 kg (150 lb)
Liquids (e.g., styrene)	2,500 L (650 gal)
Water Reactive	
Solids (e.g., sodium)	610 kg (1,350 lb)
Liquids (e.g., trichlorosilane)	6,660 L (1,760 gal)
Toxic	
Gases (e.g., nitric oxide)	1.5 m^3 (54 ft^3)
Solids (e.g., arsenic)	670 kg (1,470 lb)
Liquids (e.g., bromine)	4,900 L (1,300 gal)
Highly Toxic	
Solids (e.g., sodium cyanide)	25 kg (56 lb)
Liquids (e.g., parathion)	220 L (57 gal)
Pyrophoric	
Solids (e.g., lithium)	2.2 kg (4.90 lb)
Liquids (e.g., methyldichlorophosphine)	0.38 L (0.10 gal)
Explosives or Blasting Agents (e.g., black powder)	0.27 kg (0.60 lb)
Organic-Peroxide	
Solids (e.g., benzoyl peroxide)	0.06 kg (0.14 lb)
Liquids (e.g., acrylic resins)	1.7 L (0.44 gal)

(1) Inventory quantities are totals for each hazard group, based on data in the PNNL Chemical Management System database as of February 2006. Specific chemicals listed are examples of the types of chemicals included in each group.

Parking

The PSF parking area would be sized to provide one parking space per employee, and additional visitor parking would amount to approximately 10% of the total employee parking. Parking spaces for disabled individuals would be provided as required in both the visitor and employee parking lots.

Service Access and Design

Service access roads and loading docks would be located away from main roadways to minimize traffic hazards. Any support functions would be located in the same general vicinity as the main service courtyard area because of the similar functional requirements for truck access and storage requirements. The Radiation Detection Track would also be located in the vicinity of the service areas to potentially share the same access road and utility infrastructure.

Site Preparation

Typical site preparation would consist of clearing and grubbing surface vegetation, installing soil erosion controls, and removing superficial fill materials. Backfill materials would consist of crushed stone and structural fill, dense-graded aggregate, or other materials placed and compacted to levels recommended by the geotechnical engineer. Excavated soils would be stockpiled adjacent to the building site and would be reused onsite to the maximum extent practical.

Utilities

The City of Richland is planning to install a utility trunk loop, designed to support future development within the PNNL Site. The State of Washington has provided funds for expansion of utilities to the PNNL Site through a grant to the City of Richland from the Washington Department of Community, Trade, and Economic Development (Washington Legislature 2005). Connections would be made to existing utilities (e.g., sewage lift stations and natural gas mains). The City of Richland and Pacific Power currently maintain utility easements that run parallel to Horn Rapids Road within the PNNL Site. It is anticipated that additional easements, or an extension to the existing easement, would be established for installation of the utility trunk loop.

Utility improvements would include:

- Potable water distribution system
- Irrigation system
- Sewers, including a new sewage lift station
- Natural gas service, including mains and distribution system
- Electrical service, including conduits, duct banks, vaults, switches, and services
- Ductwork to provide fiber optic, telephone, and other communications connections.

The PSF would also include standby diesel-fueled generators to provide emergency backup power.

Water Runoff and Spill Management

Water runoff from the proposed buildings and parking areas may be collected and distributed onsite using a combination of surface swales and underground percolation beds. The swales would capture the first-flush pollutants from buildings and parking lots to percolate low-flow storm runoff. High-runoff volumes would overflow the swales into the percolation beds.

Spill containment would be provided at the laboratory facility loading dock areas. Each area would have a dry trench for spill containment and a separate storm drainage trench for rainwater. The dry trench would be a closed trench system (no piped outlet), requiring that trapped liquids be pumped into an appropriate containment vessel. Overfill prevention systems and spill containment would also be provided at the fueling area for the diesel standby generator(s).

Pollution Prevention and Waste Minimization

Consistent with the requirements and guidance of regulations and executive orders, including the *Pollution Prevention Act of 1990* (42 USC 13101), DOE incorporates pollution prevention and waste minimization practices in construction and operation of all facilities. Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use. Within DOE, pollution prevention includes all aspects of source reduction as defined by the EPA and incorporates waste minimization by expanding beyond the EPA definition of pollution prevention to include recycling. Pollution prevention is applied to all DOE pollution-generating activities, including laboratory research, development, and demonstration projects.

Pollution prevention in construction and operation of the proposed PSF would be achieved through:

- Equipment or technology selection or modification, process or procedure modification, reformulation or redesign of products, substitution of raw material, waste segregation, and improvements in housekeeping, maintenance, training, and inventory control

- Efficiency in the use of raw materials, energy, water, or other resources

- Recycling to reduce the amount of waste and pollutants destined for release, treatment, storage, and disposal.

Emergency Preparedness

DOE Order 151.1C, *Comprehensive Emergency Management System* (DOE 2005b), provides the framework for development, coordination, control, and directions of all emergency planning, preparedness, readiness assurance, response, and recovery actions. In implementing the applicable portions of that Order, PNNL prepares facility-specific emergency plans in accordance with state and federal regulations to protect workers, public health and safety, and the environment in the event of an emergency affecting PNNL. PNNL staff members participate in regularly scheduled exercises to train emergency personnel who would respond to potential accidents and other events. Emergency services for

PNNL-occupied facilities located in the Hanford Site 300 Area, as well as the PNNL Site north of Horn Rapids Road, are provided by the Benton County Sheriff and the Hanford Fire Department. Emergency services for the PNNL facilities located south of Horn Rapids Road are provided by the City of Richland. The City of Richland would also serve the PNNL Site north of Horn Rapids Road, including the PSF, if the property is annexed to the city. In the interim, DOE-SC would arrange for emergency services either from the city or from Benton County and the Hanford Site.

Provisions in the facility emergency plans would require that a hazards survey be performed for all facilities. Results of the hazards survey would be used to identify which facilities require preparation of an Emergency Preparedness Hazards Assessment (EPHA). The EPHA would describe the hazards associated with operations and materials in the facility and evaluate the consequences of events that might present a risk to health and safety of workers or members of the public. Events considered in the EPHA would include internal accidents or process upsets, external events, natural phenomena, and other events, such as sabotage or intentional destructive acts. In addition, building emergency procedures would address actions that would be taken to evaluate the severity of an actual or potential emergency and the steps necessary to notify other agencies and coordinate the response. The EPHA would also provide for the establishment of Emergency Planning Zones, where warranted, and specify Emergency Action Levels at which the hazard to workers and the public is of sufficient concern that protective action should be taken.

Emergency procedures for individual PNNL facilities would be reviewed annually and updated as needed when changes to operations could affect the level of risk associated with the facility. The building emergency procedures would describe types of hazards and operations associated with the facility as well as any administrative controls or engineered systems in place to mitigate the consequences of accidents or other off-normal events. Those controls would be commensurate with the level of risk associated with facility operations.

Safeguards and Security

In accordance with requirements in DOE Order 470.4, *Safeguards and Security Program* (DOE 2005c), and implementing guidance, PNNL currently maintains a comprehensive safeguards and security program approved by DOE and validated by external experts. PNNL employs a graded physical protection program that is systematically planned, executed, evaluated, and documented as described in a Safeguards and Security Plan. Under this approved program, DOE assets are appropriately protected from malevolent acts such as theft, diversion, and sabotage, as well as events such as natural disasters and civil disorder, by considering site and regional threats, protection planning strategies, and protection measures. Public access to the perimeter of the PNNL Site and buffer area would be limited through the installation of a fence, wall, or other barrier that meets safeguards, security, and facility safety requirements.

Based on threat assessments and protection planning strategies, the PSF would be designed to provide the appropriate level of physical protection required by DOE for Property Protection Areas (PPAs) and Limited Areas (LAs). PPAs would be established where required to protect government-owned property against damage, theft, or intentional destructive acts. LAs are security areas designated for the protection of classified matter and certain types of special nuclear material. Specific physical protection requirements for these security areas are provided as follows:

Property Protection Areas

- General Requirements. PPAs must be configured to protect Government-owned property and equipment against damage, destruction, or theft and must provide a means to control public access.

- Access Control. Some form of access control shall be implemented to protect employees, property, and facilities. PNNL employs automated access control systems, i.e., proximity card readers and/or lock systems.

- Signs Prohibiting Trespassing. Signs prohibiting trespassing must be posted around the perimeter and at each entrance to the PPA.

- Physical Barriers. Physical barriers such as fences, walls, and doors may be used to identify the boundary of the PPA. PNNL's protection strategy for PPAs relies on the building perimeter (i.e., walls) as the physical barrier and legal demarcation for the PPA boundary.

Limited Areas

- General Requirements. LAs are defined by physical barriers encompassing the designated space and access controls to ensure that only authorized personnel are allowed to enter and exit the area. A means must be provided to detect unauthorized entry into the LA. The PNNL protection strategy recognizes that "signs of forced entry" and the "audit" feature of automated access control systems are acceptable means of detection.

- Personnel and Vehicle Access Control. The identity and access authorization of each person seeking entry must be validated by appropriate authorized personnel, automated systems, or other means documented in the safeguards and security plan. The current protection strategy employed at PNNL consists of proximity cards or other lock systems with a personal identification number. Vehicles are not authorized in PNNL LAs.

- Physical Barriers. Physical barriers, such as fences, walls, and doors, may be used to identify the boundary of the LA. PNNL protection strategy for LAs typically consists of exterior and/or interior walls of commercial-grade construction, with the only criteria that the interior walls extend from the "true" floor to the "true" ceiling. General Services Administration-approved security containers are currently used to store classified matter and some special nuclear materials. If additional protection is required, intrusion detection systems may be installed within in LAs.

A plan is currently in place at PNNL to implement special security measures when warranted by an increased threat of intentional destructive acts or other events. The types and frequency of measures implemented would depend on the declared threat level and would employ a graded approach that involves actions by staff, onsite security personnel, and community emergency response agencies as applicable.

Future Development

Although future research needs cannot be predicted at this time, portions of the PNNL Site and buffer area may eventually be developed to meet DOE-SC programmatic needs unrelated to the proposed action discussed in this EA. Any such development would be in accordance with existing or future agreements among DOE, tribal, and regulatory agencies. Appropriate NEPA reviews would be conducted at that time to evaluate any future proposals.

3.2 Alternatives Considered but Not Evaluated in Detail

Relocating research activities from the 300 Area would involve replacing up to 17 identified technical and support capabilities that currently exist at PNNL, and DOE-SC has evaluated a number of alternatives for housing the capabilities that are expected to continue or expand as part of ongoing programs. DOE considered the need for each identified mission scope and issued a Final Mission Needs Validation Report in Support of the PNNL Capability Replacement Laboratories Project (DOE-PNSO 2005). As part of that evaluation, DOE considered replacing all, part, or none of the capabilities that will be displaced by closure of 300 Area facilities occupied by PNNL. The report identified capabilities considered critical to DOE and other federal agency strategic missions as the programmatic basis for the PSF conceptual design. Failure to provide those research capabilities would result in the agencies' inability to carry out their essential functions and programs. Based on the needs of ongoing DOE, NNSA, and DHS missions, DOE-SC established a requirement that replacement facilities must be acquired at PNNL to accommodate critical capabilities that will be displaced by closure of the 300 Area laboratories.

Criteria used to evaluate alternatives for replacement facilities included values such as community impact, workplace quality, safety, expandability, collaboration, connectivity, flexibility, energy efficiency, sustainable design, compatibility with DOE-SC and PNNL real estate strategy, and the ability to benefit multiple programs via opportunities for discovery and utilization of unique capabilities. The DOE-SC preferred approach to meeting facility needs for the technical capabilities identified as part of the proposed action is discussed in Section 3.1. The alternatives analysis (PNNL 2005) considered the proposed action, which was identified as "Construct new facilities using a mixed financing approach," in addition to three other viable alternatives:

1. Utilize existing federally owned facilities at or near PNNL
2. Utilize existing privately owned facilities at or near PNNL
3. Construct new facilities on DOE property using line item funding.

The proposed action was selected from among the alternatives on the basis of life-cycle cost and operational efficiency. Alternatives to the proposed action are discussed in the following sections. Their environmental impacts, as well as other logistical and programmatic considerations, are evaluated qualitatively relative to those for the proposed action.

Alternative 1. Utilize existing federally owned facilities at or near PNNL

The option to relocate PNNL technical capabilities from the 300 Area to other existing DOE-owned facilities on the Hanford Site was explored in detail. Because of the extensive scope of the Hanford closure plan, many existing DOE facilities are scheduled for removal and represent significant cleanup mortgages, similar to the 300 Area facilities currently occupied by PNNL. At present, only the Fuels and

Materials Evaluation Facility (FMEF), located in the Hanford Site 400 Area, would have the available capacity to warrant consideration. That facility was designed for testing and examining nuclear fuels from the Fast Flux Test Facility, which has been deactivated. The FMEF was never occupied and would require extensive modification to support research being conducted at PNNL. This alternative was estimated to meet the relocation schedule; however, the requirement for expansion of FMEF or acquisition of leased space added substantial cost. In addition, this alternative would not result in optimum co-location of technical capabilities to promote collaboration and efficient use of unique or common resources needed by different programs, resulting in fragmentation of the laboratory and isolation of research staff from other resources in existing PNNL facilities. The use or expansion of existing DOE facilities was not considered a reasonable alternative to meet the purpose and need for action, as described in Section 2, because of the limited availability of suitable existing facilities, substantial cost to retrofit any other facilities that may be candidates, and detrimental impacts on laboratory operations from moving the 300 Area capabilities to a location remote from existing PNNL facilities. The use of existing facilities at other DOE sites was also evaluated, but was not considered reasonable because of similar limitations.

Alternative 2. Utilize existing privately owned facilities at or near PNNL

The second alternative evaluated was relocation of PNNL technical capabilities from the 300 Area to other non-DOE owned facilities that already exist in the vicinity. Because of the space and unique facility requirements for relocated technical capabilities, the likelihood of finding available space within a reasonable distance of the existing PNNL facilities was judged to be remote. Facilities currently occupied by PNNL are not capable of accommodating the needs of the relocated technical capabilities through assimilation or displacement because existing space is expected to be fully utilized with equally critical work supporting DOE and other federal missions. Privately owned laboratory facilities in the vicinity are also fully occupied by PNNL under lease agreements. A recent rental market survey (PNNL 2005, Attachment 1) indicated that there was no available laboratory space and insufficient office space to accommodate the relocated capabilities within 10 miles of PNNL. Leasing facilities more remote from PNNL could potentially meet the relocation schedule; however, that option was associated with considerable uncertainty because of the number of leased facilities required to accommodate space needs. This alternative also would not result in optimum co-location of technical capabilities to promote collaboration and efficient use of unique or common resources needed by different programs because it would result in fragmentation of the laboratory and isolation of research staff from other resources in existing PNNL facilities. For reasons similar to those discussed relative to Alternative 1, the use of existing private facilities was not considered a reasonable alternative to meet the purpose and need for action as described in Section 2.

Alternative 3. Construct new facilities on DOE property using line item funding

This alternative considered construction of all required facilities on government-owned land using line-item funding, which would have the advantage of consolidating all relocated technical capabilities in a single location or in close proximity. It would also rely on only one major funding source and reduce the requirement for budgetary coordination among different agencies. One disadvantage associated with this alternative is that it would not provide for optimum operational efficiency that would result from integrating relocated capabilities with similar synergistic capabilities currently located in existing PNNL facilities. In addition, it would not take advantage of multiple capital funding sources, resulting in the highest initial cost to the government. This alternative could potentially meet the relocation schedule; however, it would not provide the optimum opportunity for collaboration among technical capabilities because of the requirement to build line item-funded facilities on government property. It would limit flexibility to locate some capabilities near existing PNNL facilities that occupy both privately owned and government-owned property. Construction of a new facility using DOE line item funding was not considered a reasonable alternative to meet the purpose and need for action, as described in Section 2, because of the high initial cost and detrimental impacts on laboratory operations from duplicating or separating capabilities that require common equipment, staff, and resources.

Environmental Impacts of Alternatives

Using existing facilities as described for Alternatives 1 and 2 could result in some reduction of resources needed for initial construction. However, the availability of suitable facilities is limited, and it would likely be impractical to retrofit existing facilities to meet the requirements for some capabilities, such as shielded operations, or other activities where materials or information security is required. Using existing facilities could also result in higher resource use and costs for operation over the long term, particularly for older, less efficient, buildings.

Relocating the technical capabilities from the 300 Area to existing facilities at another DOE site would require transporting existing equipment and materials to the alternate facility, as well as transferring or replacing key technical staff. Additional transportation impacts would occur if the capabilities were relocated to a DOE site distant from the 300 Area, and that alternative would entail higher costs for moving or replacing essential staff, equipment, and materials. It would also result in substantial disruption of the affected programs as staff relocated to a new community, or their replacements were trained.

In general, resources needed to construct the proposed laboratory complex under Alternative 3 would be similar to the proposed action wherever the facilities were located. However, some types of environmental impacts associated with this alternative would depend on the specific site selected. In particular, the potential for impacts on cultural and biological resources would be unique to each site, as would some impacts on surrounding residential and commercial areas.

3.3 No-Action Alternative

Under the No-Action Alternative, DOE-SC would not obtain replacement facilities or provide new facilities for PNNL staff and existing research missions. Ongoing work in the 300 Area would continue until PNNL is required to vacate the facilities to allow completion of 300 Area cleanup. At that point, the research underway would cease. Environmental impacts of the No-Action Alternative are discussed in Section 5.2.

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4.0 Affected Environment

The planned location for construction of the PSF is within the PNNL Site, located directly north of Horn Rapids Road (Figure 3.1). Aspects of the site and its environs that might be affected by the construction and operation of the PSF are described in this section.(3)

4.1 Land Use

The proposed PSF construction site within the PNNL Site is vacant DOE-owned property that was reassigned in 2004 to DOE-SC from the Hanford Site. The site is a relatively level parcel of land covered with a mix of desert-adapted shrubs and grasses. The DOE property to the north and east of the current PNNL Site is also vacant and is currently being reassigned to DOE-SC for use as a controlled- access buffer area. Most of the property within the proposed PSF construction site and buffer area was designated as Industrial in a 1999 DOE Record of Decision (ROD) for the *Final Hanford Comprehensive Land-Use Plan EIS* (64 FR 61615). The exception was a section in the eastern part of the buffer area along the Columbia River, which was designated as Preservation in the 1999 ROD to protect sensitive Tribal cultural sites. The PNNL Site and buffer area are designated as Business/Research Park in Benton County's Comprehensive Plan. They are also within the City of Richland urban growth area and are designated as a mix of Business/Research Park (similar to the adjacent PNNL facilities), Commercial, and Low Density Residential land uses.

Land use in nearby areas includes:

- Existing PNNL facilities, directly south of Horn Rapids Road, including the EMSL as well as other research laboratories and support buildings.
- Businesses located east of George Washington Way and south of Horn Rapids Road.
- The Columbia River, located due east, which can support a diverse mix of recreational and subsistence-fishing uses.
- A planned condominium community currently being constructed along the Columbia River south of Horn Rapids Road.
- A barge-docking facility, located to the southeast, that is used for transferring reactor components and other materials destined for the Hanford Site. A haul road connecting the barge facility to Stevens Drive traverses the buffer area from southeast to northwest.

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(3) Because the proposed construction site and buffer area have historically been part of the Hanford Site, information in this section is based on the *Hanford Site National Environmental Policy Act (NEPA) Characterization* report (Neitzel 2005) unless indicated otherwise. Although the property has been, or is in the process of being, reassigned to DOE-SC, the descriptions in that document apply to the corresponding areas as discussed in this EA.

- The Washington State University (WSU)-Tri-Cities branch campus, Hanford High School, and Richland residential area are located to the south-southeast.
- Occupied and unoccupied Hanford Site land is adjacent to the west and north.
- Industrially and agriculturally developed land that lies to the southwest (all zoned industrial by the City of Richland).

4.2 Air Quality

Air quality within the region is generally good with occasional exceptions caused by blowing dust. Atmospheric dispersion is relatively good with infrequent periods of stagnation occurring mostly during winter months. Air quality within Benton County, including the PNNL Site, has been designated as being in attainment with all EPA and State of Washington non-radiological air quality standards.

Federal and State of Washington requirements specify that routine radioactive air emissions may not exceed a quantity that results in an annual dose of 10 mrem to a maximally exposed member of the public. Doses due to airborne effluents released from 300 Area facilities have been evaluated annually for a maximally exposed individual (MEI)[(4)] and for the collective population within 80 km (50 mi) of the site (Poston et al. 2002, 2003, 2004, 2005, 2006). Emissions from PNNL-occupied facilities account for essentially all of the airborne effluents released from the 300 Area, and for purposes of analysis, doses reported for the 300 Area were considered to reflect those from ongoing PNNL activities. During the years 2001 to 2005, air emissions from 300 Area stacks resulted in doses to the MEI ranging from 0.0073 to 0.021 mrem per year, depending on the types and quantities of radionuclides in various facility effluents. Collective doses[(5)] from 300 Area airborne effluents to the population within 80 km (50 mi) ranged from 0.085 to 0.33 person-rem during that same period. For perspective, the population within 80 km (50 mi) of the 300 Area received about 100,000 person-rem in 2005 from background sources of radiation.

4.3 Geological Resources

Geological resources in the vicinity of the PNNL Site consist principally of Rupert Sand and Burbank Loamy Sand overlying Pleistocene (1.8 to 0.01 million years ago) Ice Age Flood sediments, Pliocene (5.3 to 1.8 million years ago) ancestral Columbia River and Snake River sediments, and Miocene (24 to 5.3 million years ago) Columbia Plateau Basalt Flows. Like much of the region, the Ice Age Flood sediments and surface soils are characterized by high infiltration rates, low-water-holding capacities, and very low clay and organic matter content.

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(4) The location of the Hanford Site MEI can vary from year to year depending on the nature of onsite activities and their relative contributions to radioactive emissions. During the past 5 years, the MEI has twice been located in the Riverview area across the Columbia River from Richland and three times in the Sagemoor area across the river from the 300 Area.

(5) The collective dose is the sum of the dose received by all individuals in a population and is expressed in units of person-rem. For example, a dose of 1 rem to each of 10 individuals would result in a collective dose of 10 person-rem.

4.4 Water Resources

There are no naturally occurring surface water bodies, wetlands, or designated floodplains on the PNNL Site. The Columbia River is located directly to the east, and the Yakima River is located about 4.8 km (3 mi) to the southwest of the site.

Groundwater beneath the PNNL Site generally originates as natural recharge from local rain and snowmelt at higher elevations to the west and eventually discharges to the Columbia River. The unconfined water table under the site is generally 9 to 19 m (30 to 62 ft) below the ground surface. Fluctuations in the Columbia River flow affect the groundwater levels at the site.

4.5 Cultural and Historical Resources

Cultural and historical resource assessments of the proposed construction site identified trash scatters of cans and glass and ceramic fragments that might be of possible historic interest (Appendix A). In addition, the site includes a segment of Lateral #4 of the Richland Irrigation Canal, built by the Lower Yakima Irrigation Company (1908 to 1909) to promote agricultural development around the town of Richland (Figure 4.1). The canal was apparently prone to leakage, and a portion was lined with cement in 1922. Isolated portions of the canal still possess an intact cement liner, and an inscription is present on one segment. On December 8, 1994, the State of Washington Historic Preservation Officer (SHPO) concurred that Lateral #4 is eligible for the National Register of Historic Places because of its contribution to early farm settlement in the region between 1900 and 1943.

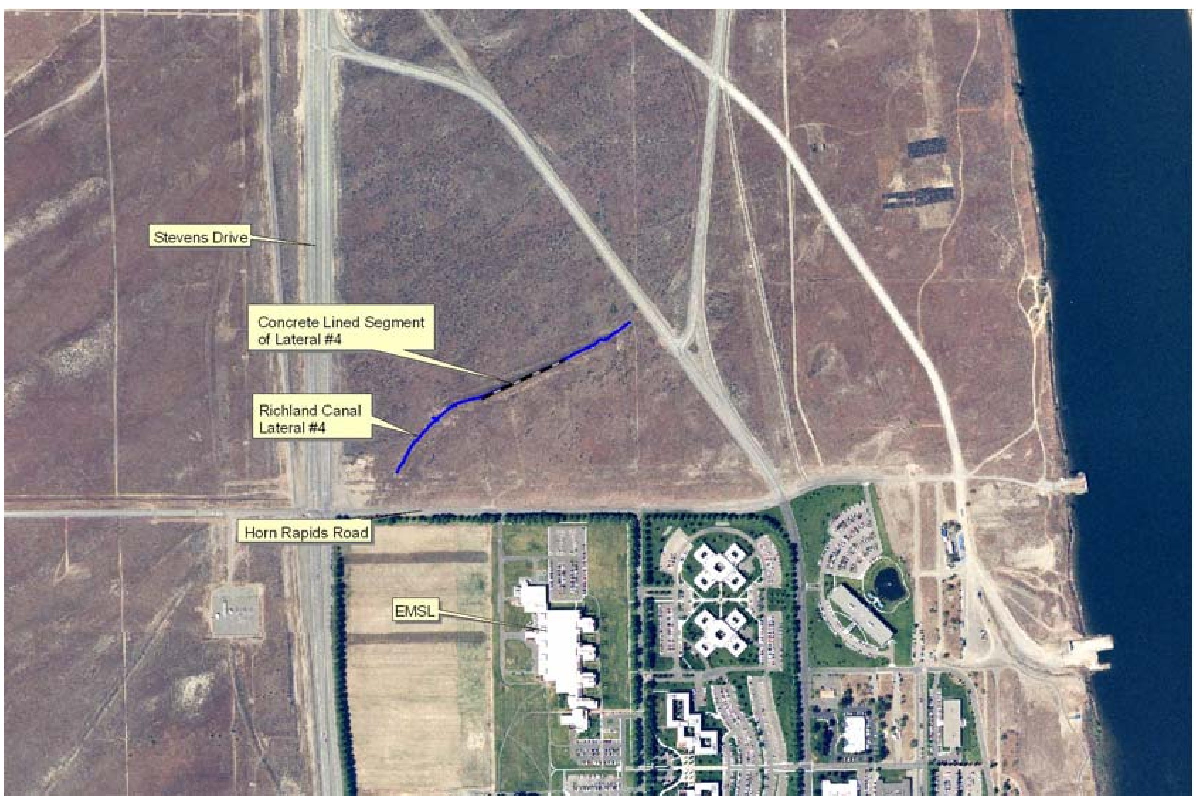

Figure 4.1. Schematic Showing a Segment of Lateral #4 of the Richland Irrigation Canal

In 1994, excavation in the eastern portion of the buffer area identified a site of cultural significance to regional Tribes. As a result of this cultural resource concern, DOE committed to protect the area from future disturbances and established a perimeter fence around the area. In addition, two prehistoric sites are located in the eastern portion of the buffer area near the shore of the Columbia River. These sites are listed on the Washington State Heritage Register as part of the Hanford South Archaeological District. The sites are within the Preservation[(6)] designated area established by the DOE ROD for the Final Hanford Comprehensive Land-Use Plan EIS (64 FR 61615). The sites are monitored annually to confirm that they remain undisturbed and that existing protective measures are effective.

4.6 Biological Resources

A list of federally threatened and endangered plant and animal species of potential interest at the PNNL Site were identified through the U.S. Fish and Wildlife Service (USFWS) Threatened and Endangered Species System (USFWS 2006). Biological surveys of the proposed construction site have been conducted each spring from 2003 to 2006 (Sackschewsky 2003, 2004, 2005, Appendix B). However, no federal or state threatened or endangered species, species proposed for listing, or critical habitat were observed during any of these surveys. The 2006 survey report is provided in Appendix B and includes a complete list of all plants and wildlife (including genus and species names) observed during these surveys. The following discussion includes both species observed onsite and those that might occur at the site based on habitat affinities.

The southern portion of the construction site consists of approximately 14 ha (35 ac) located immediately north of Horn Rapids Road and south of the Richland Irrigation Canal. This area has been previously disturbed and supports vegetation dominated by cheatgrass, Russian thistle, and Sandberg's bluegrass. Shrubs are sparse over most of this area where big sagebrush, bitterbrush, gray rabbitbrush, and snow buckwheat each contribute approximately 1% cover. Large native bunchgrasses, especially Indian ricegrass, sand dropseed, and needle-and-thread grass, provide a total of 2 to 3% cover.

The northern portion of the construction site consists of approximately 26 ha (64 ac) located north of the Richland Irrigation Canal. This area consists of a mature stand of shrub-steppe dominated by big sagebrush, cheatgrass, and Sandberg's bluegrass. Bitterbrush is noticeable but is much less prevalent than big sagebrush. The total shrub cover is over 20%. The larger bunchgrasses noted above in the southern portion of the site are less prevalent in the northern portion.

Ground-nesting birds observed in 2006 include Western meadowlarks, California quail, and burrowing owls (federal species of concern, state candidate species). Meadowlarks nest in a wide variety of shrub-steppe habitat, and thus likely nest in the vicinity. California quail could nest on the site because food and water are available in the adjacent lawn areas south of the site. One burrowing owl was observed in February 2006 at a burrow in the northern tip of the site. However, during the April 2006 survey, no owls were observed, and the burrow appeared to have since been filled in with soil excavated by rodents. Although burrowing owls are not nesting in the site, they could potentially nest there. Long-billed curlews were observed in the 2006 survey west of Stevens Drive outside the PNNL Site. Curlews typically nest on the ground in open areas within shrub-steppe. Thus, although curlews have not been

(6) An area managed for the preservation of archeological, cultural, ecological, and natural resources.

observed nesting in the PNNL Site, they could potentially nest there. The horned lark is a ground-nesting species that was not observed during the surveys, but they are relatively abundant and commonly nest in a wide variety of shrub-steppe habitats.

No shrub-nesting birds were observed in 2006. The lark sparrow is a shrub-nesting species that was observed most recently in the 2004 survey and could potentially nest onsite. Other shrub-nesting birds, such as sage sparrows (state candidate species) and loggerhead shrikes (federal species of concern, state candidate species), were not observed during any of the surveys but could potentially nest on the site. Because detection of nests would require a much more intensive field survey, the lack of observed nests does not preclude the possibility that these species nest in the PNNL Site.

Several additional bird species were commonly observed during the surveys, but are not expected to nest in this habitat, including white-crowned sparrows, black-billed magpies, European starlings, mourning doves, and ring-necked pheasants.

Mammals observed, or their sign, include the northern pocket gopher, badger, coyote, and mule deer. Northern pocket gopher excavations were extensive. Badger excavations were observed throughout the site, but none appeared to be active. Coyote excavations (presumably for hunting rodents) were observed throughout the site. Mule deer sign was observed infrequently. Signs of black-tailed jackrabbit, also potentially present in this shrub-steppe habitat, were not observed.

4.7 Status of Groundwater and Surface Contamination

The portion of the PNNL Site located north of Horn Rapids Road is included in two *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA; 42 USC 9601 et seq.) operable units. One operable unit (300-FF-5) addresses groundwater contamination, and the other (300-FF-2) addresses surface-area contamination. The operable units are part of the “Hanford 300 Area” National Priorities List per 40 CFR Part 300, listed on November 3, 1989. Under the Hanford Site Tri-Party Agreement (Ecology et al. 1989), waste sites were grouped into “operable units” based on geographic proximity or similarity of waste-disposal history.

Groundwater under the northern part of the site is part of the Hanford 300-FF-5 operable unit. The Hanford groundwater monitoring report (Hartman et al. 2006) indicates that four contaminants (uranium, tritium, cis-1,2,-dichloroethene, and nitrate) are found at levels that exceed drinking water standards in parts of the operable unit. Beneath the PSF construction site, those contaminants were either not detectable or were present in concentrations well below drinking water standards, except for nitrate, which exceeded drinking water standards. The nitrate plume underlying much of north Richland originates from offsite activities and is not identified as a contaminant of concern for the 300-FF-5 operable unit. The selected remedy in the 300-FF-5 interim ROD (EPA 1996) includes requirements for monitoring groundwater concentrations of uranium, tritium, and cis-1,2-dichloroethene, and requires that DOE maintain institutional controls to restrict groundwater use and minimize potential impacts on public health or safety.

The portion of the PNNL Site located north of Horn Rapids Road is also a small part of the Hanford 300-FF-2 surface operable unit. Two waste sites located within this unit have been investigated as part of the CERCLA process. A CERCLA interim ROD (EPA 2001) concluded that there was no significant regulated waste at either waste site, and no further remedial action was required.

Although not required for the construction of PSF, DOE-PNSO is working with the EPA and the Washington State Department of Ecology (Ecology) to remove the portion of the PNNL Site located north of Horn Rapids Road from the National Priorities List. Documentation will be submitted to the EPA for consideration, and if acceptable, the site will be a partial deletion from the National Priorities List.

4.8 Socioeconomics/Demographics

Activities on the Hanford Site and at PNNL play a substantial role in the socioeconomics of the Tri-Cities and other parts of Benton and Franklin counties. Since the 1970s, DOE and its contractors have been one of three primary contributors to the local economy (the other two are Energy Northwest and the agricultural community). Increasingly, a growing cluster of technology-based businesses, many with roots in PNNL and the Hanford Site, are playing a role in the expansion and diversification of the local private business sector. Together, PNNL and PNSO had a total of about 4,320 employees in June 2006. In addition, the Hanford Site (DOE-RL, DOE-ORP, and their contractors) employed about 7,490 workers in June 2006.[7] It is expected that as the Hanford Site cleanup workforce decreases over the next several decades, the PNNL workforce will contribute a larger share to the Tri-Cities economy.

According to the 2000 Census, population totals for Benton and Franklin counties were 142,475 and 49,347, respectively (Elliott et al. 2004). Both Benton and Franklin County grew at a faster rate than Washington state as a whole during the 1990s. The population demographics of Benton and Franklin counties are quite similar to those found within Washington, although the population of Benton and Franklin counties is somewhat younger than that of Washington as a whole. Additional information, including a detailed breakdown of minority and low-income populations in the vicinity, can be found in Elliott et al. (2004).

In 2000, the population within an 80-km (50-mi) radius of the 300 Area meteorological tower[8] was about 349,000 and included about 37% minority persons[9] (in order of percentage contribution, Hispanic and Latino, Native American, Asian and Pacific Islanders, and African-American). The Hispanic population resides predominantly in Franklin, Yakima, Grant, and Adams counties. Native Americans within the 80-km area reside primarily on the Yakama Reservation and along the Columbia River near the town of Beverly, Washington (Figure 4.2).

In 2000, the population within an 80-km (50-mi) radius of the 300 Area meteorological tower included 16% low-income[10] residents. The majority of these households were located to the southwest and northwest (in Yakima and Grant counties) and in the cities of Kennewick and Pasco (Figure 4.3).

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(7) Personal communication, Cindy L. Oliver, DOE-RL Contractor Industrial Relations team.
(8) The 300 Area meteorological tower was selected as the center point because it is the reference point at which census data have historically been evaluated, and it adequately represents the population distribution surrounding both the 300 Area and the proposed PSF.
(9) The minorities designation in the census data counts both racial minorities Alaska Native, African-American, Native American, Pacific Islander, and either mixed race or “other” race, and Hispanics and Latinos (Elliot et al. 2004).
(10) Low-income persons are defined as living in households that report an annual income less than the United |States’ official poverty level ($17,761 for a family of four in 2000), as reported by the Census Bureau.

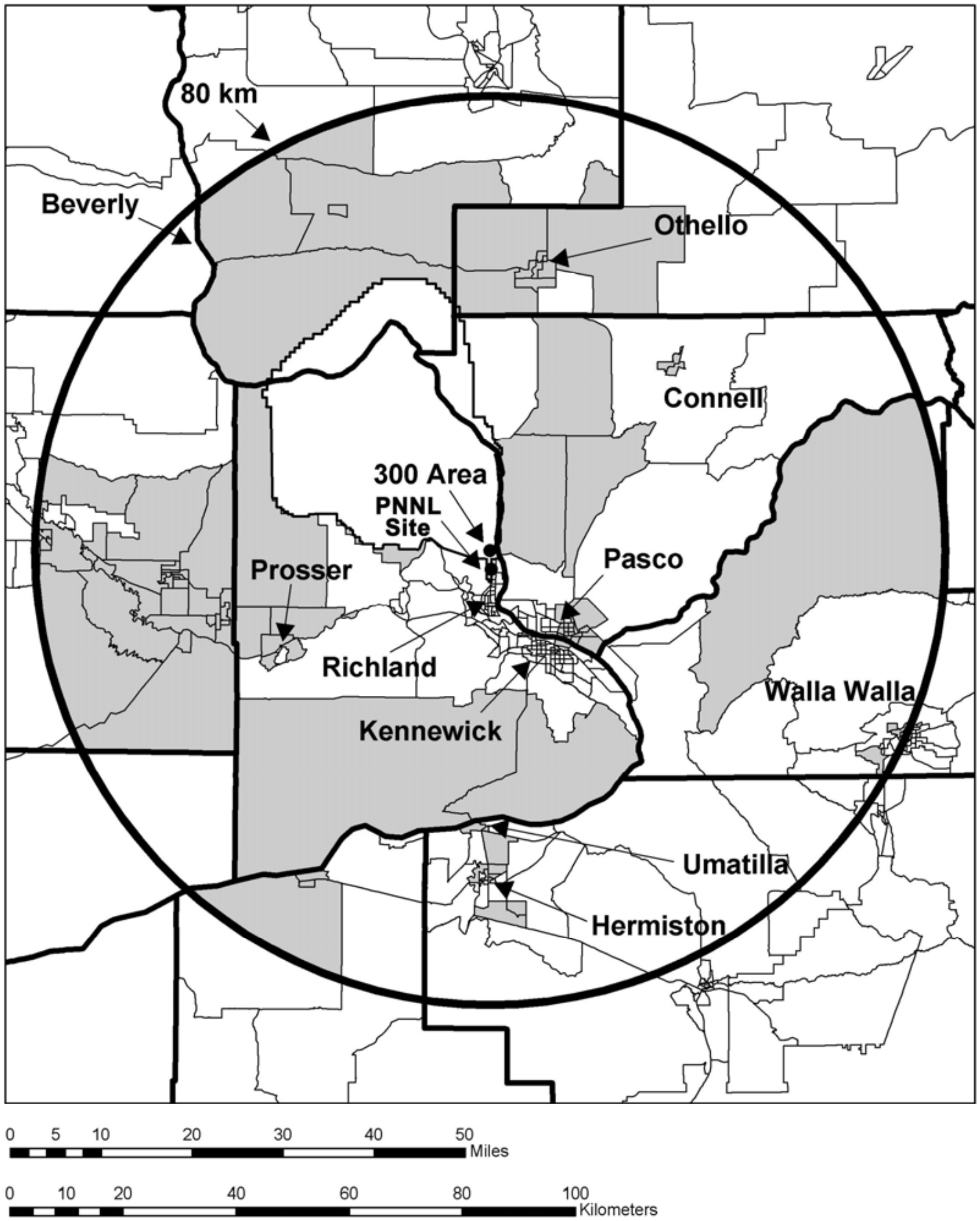

Figure 4.2. Location of Minority Populations near the PNNL Site

(Shaded areas indicate regions that have a majority of residents who are members of a minority group or for which the percentage of minority population is 20 percentage points greater than the statewide average.)

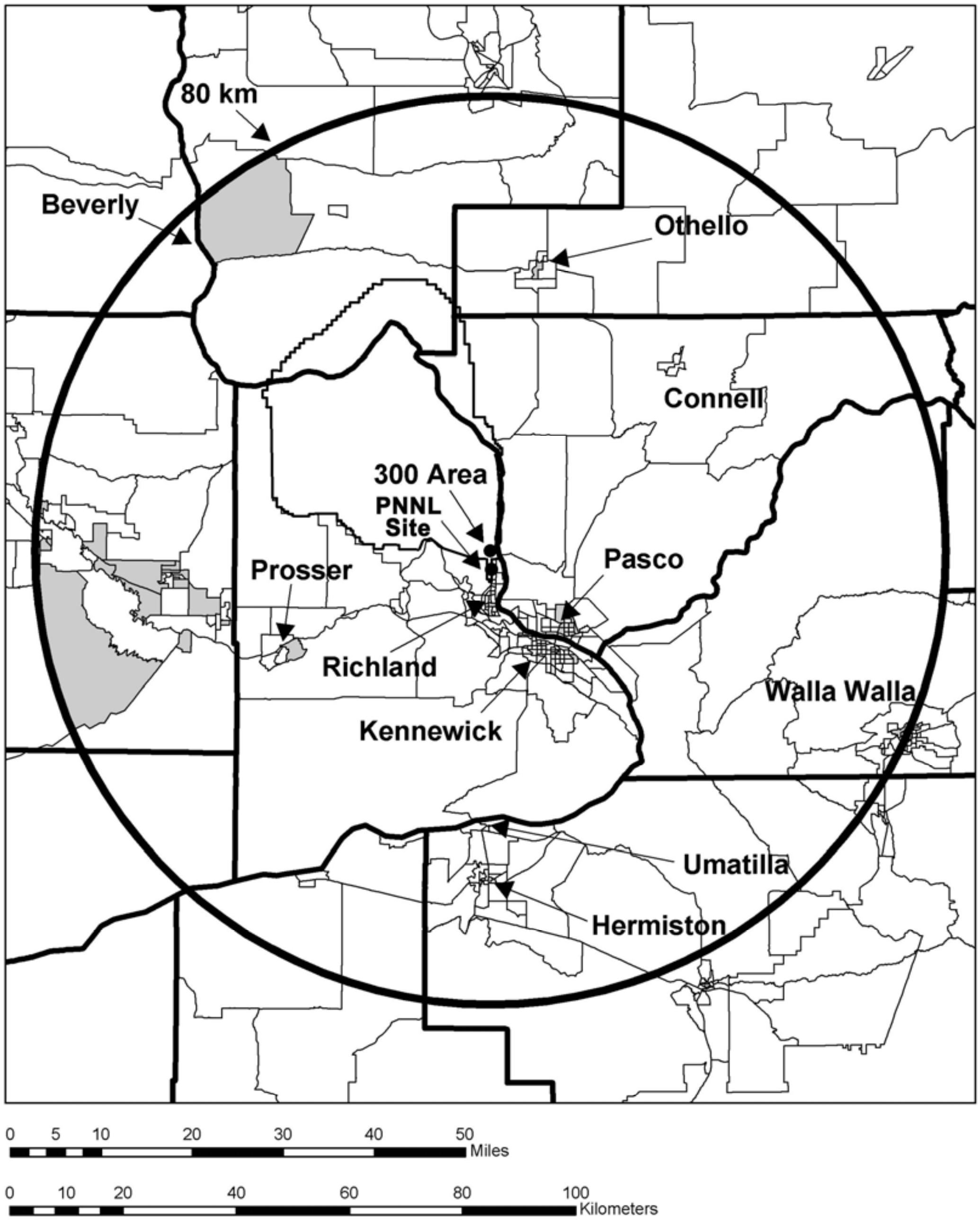

Figure 4.3. Location of Low-Income Populations near the PNNL Site

(Shaded areas indicate regions that have a majority of low-income residents or for which the percentage of low-income residents is 20 percentage points greater than the statewide average.)

4.9 Transportation

The Tri-Cities serves as a regional transportation and distribution center with major air, rail, highway, and river connections. Daily air passenger and freight services connect the area with most major cities through the Tri-Cities Airport, located in Pasco. Passenger rail service is provided by Amtrak, which has a station in Pasco. Freight rail service adjacent to the PNNL Site is maintained and operated by the Tri-City and Olympia Railroad Company. The regional highway network in the vicinity consists of several main routes: a DOE-maintained road network within the Hanford Site; State Route 240, a 6-lane highway that feeds to Stevens Drive in Richland; George Washington Way, a principal 4-lane north-south arterial through Richland; and State Route 224 (Van Giesen Street), which is used by commuters from West Richland and Benton City. The main arteries that feed to the PNNL Site are Stevens Drive and George Washington Way. In 2004, the City of Richland found that Stevens Drive (north of Horn Rapids Road) had an average weekday traffic count of 6,089 and George Washington Way (north of Horn Rapids Road) had an average weekday traffic count of 1,719 (City of Richland 2006a). At peak periods, commuter traffic is often heavy on all primary routes to and from the Hanford Site and PNNL. The Washington State Department of Transportation is in the process of widening State Route 240 between Richland and Kennewick and revising traffic flow to relieve congestion.

4.10 Occupational Health and Safety

Over a 5-year period from 2001 to 2005, the total recordable cases[(11)] of injuries and illnesses at PNNL averaged 1.4 cases per 200,000 worker hours (DOE 2006a). This rate is lower than the average incidence rate for DOE sites (1.9 cases per 200,000 worker hours). For comparative purposes, the DOE average incidence rates were well below the Bureau of Labor Statistics rates for U.S. private industry of 5.4 cases per 200,000 worker hours during the 5-year period from 2000 to 2004 (most recent data available) (DOE 2006a).

The DOE Office of Environment, Safety and Health reports occupational radiation exposure data for monitored DOE and contractor employees. In 2005, 726 PNNL workers were monitored for occupational radiation exposure. Of that number, 118 workers had a measurable Total Effective Dose Equivalent (TEDE).[(12)] The average measurable TEDE was 115 mrem, and the maximum dose received by any worker was less than 1000 mrem. The PNNL collective dose, which is an indicator of the overall workforce radiation exposure, was about 13 person-rem (DOE 2006b). For perspective, these 726 individuals would have received about 220 person-rem from background radiation sources during 2005.

(11) Total recordable cases are the total number of work-related injuries or illnesses that resulted in death, days away from work, job transfer or restriction or other recordable cases, consistent with U.S. Occupational Safety and Health Administration definitions.

(12) The Total Effective Dose Equivalent is defined as the sum of the dose from radiation sources internal and external to the body, reported in units of rem or mrem. Collective dose is the sum of doses to all individuals in a population and is reported in units of person-rem. For example, a dose of 1 rem to each of 10 workers would result in a collective dose of 10 person-rem TEDE.

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5.0 Impacts of Proposed Action and the No-Action Alternative

DOE proposes to construct and operate the PSF to accommodate existing PNNL research activities that will be displaced by cleanup of the Hanford Site 300 Area. Because the impacts described in this section would result principally from relocation of existing activities that have had minimal environmental impacts over the past 40 years, or from ceasing those activities, the incremental impacts of the proposed action or the No-Action Alternative are generally expected to be minimal. Potential impacts in the environs of the PNNL Site as a result of implementing the proposed action or the No-Action Alternative are described in the following sections.

5.1 Environmental Impacts of the Proposed Action

As described in Section 3, options are being considered to construct the PSF in phases over a period of approximately 20 years. However, environmental impacts are presented in this section as though construction of the entire PSF were completed within a period of about 2 years, and PNNL research operations were transferred from the 300 Area to the PSF at that time. As a consequence, time-dependent construction impacts, such as those on traffic and air quality, may be overstated in the analysis that follows. Therefore, this approach is expected to bound the environmental impacts of PSF construction for whatever schedule is ultimately selected.

In a phased implementation, some of the potential impacts from PSF operations would be delayed until the full facility is completed. However, because the proposed action involves replacement of facilities for existing PNNL research capabilities in the 300 Area, operational impacts from activities that are not immediately relocated to the PSF would continue in the 300 Area facilities. For most environmental consequences associated with research operations, the impacts would be similar wherever those activities occurred.

Potential environmental impacts as a result of implementing the proposed action are described in the following sections.

5.1.1 Land Use

As discussed in Section 3.1 and illustrated in Figure 3.1, implementing the proposed action would involve construction and operation of the PSF for conducting R&D activities on the PNNL Site. For the most part, R&D activities proposed for relocation to the PSF are currently conducted in PNNL-occupied facilities located in the 300 Area of the Hanford Site, which is in the process of remediation leading to closure.

The current PNNL Site includes EMSL, which is located due south of Horn Rapids Road, as well as vacant property north of Horn Rapids Road between Stevens Drive and George Washington Way. The proposed PSF, including parking lots and landscaping, would occupy about 31,000 m^2 (~3 ha), or 332,000 ft^2 (~8 ac), of a plot of about 20 ha (50 ac) within the current PNNL Site north of Horn Rapids Road. An additional adjacent area of up to 12 ha (32 ac) would likely be disturbed during construction for access roads and construction materials laydown.

The land where the PSF is proposed to be constructed is owned by DOE and was reassigned from the Hanford Site to DOE-SC in 2004. Prior to that time, the site was classified as Industrial in a DOE ROD for the *Final Hanford Comprehensive Land-Use Plan EIS* (64 FR 61615). Although the PNNL Site is no longer within the Hanford Site, establishing R&D operations at the proposed site would be consistent with the intent of the Industrial designation for that land, as provided for in the earlier DOE ROD.

The PNNL Site is within the City of Richland's planned Urban Growth Area Boundary. Both the PNNL Site and existing PNNL facilities within the Richland city limits are designated as "Business/Research Park" under Richland's Comprehensive Plan Land-Use Designation (City of Richland 2005a). The proposed site is also identified as an Urban Growth Area by Benton County and is designated as Business/Research Park in Benton County's Comprehensive Plan (Benton County Planning Department 2005). Although the federal government is not subject to local planning authority, the activities within the proposed site for construction and operation of the PSF would be consistent with adjacent land uses planned by the City of Richland and Benton County; therefore, no incompatibility issues would be anticipated.

DOE is also in the process of reassigning property to the north and east of the current PNNL Site from the Hanford Site to DOE-SC. This property would serve as a restricted-access buffer area for the proposed facility. The expanded PNNL Site north of Horn Rapids Road, including the buffer area, would extend from Stevens Drive on the west to the Columbia River on the east, and from Horn Rapids Road on the south to an east-west line approximately 1,100 m (3,500 ft) north of Horn Rapids Road. If DOE ultimately constructs PSF modules for all the of technical capabilities that have been identified for relocation, existing roads through the buffer area that connect George Washington Way to Stevens Drive and the 300 Area, as well as the bike path north of Horn Rapids Road, could be closed to public access.

The fenced area within the eastern portion of the buffer area was assigned Preservation status in the DOE (1999) EIS. The haul road that crosses the buffer area from the Port of Benton barge facility to Stevens Drive would be maintained for future use.

5.1.2 Air Quality

Potential impacts on air quality from release of SO_2, NO_2, and other criteria pollutants are described in this section. Details of calculations are provided in Appendix C. Impacts from the release of other chemicals and radionuclides are described in Section 5.1.12, Human Health and Safety.

Construction

Construction of the PSF is anticipated to begin in late 2007 or early 2008, and for purposes of this analysis is estimated to take approximately 2 years. In a phased construction, the impacts as described in this section would be similar, but would occur over a longer period of time. During that time, the operation of diesel-powered construction equipment would be expected to introduce quantities of SO_2, NO_2, particulates, and other pollutants to the atmosphere, typical of similar-sized construction projects. These releases would not be expected to cause any air-quality standards to be exceeded. Regardless, dust generated during earthmoving activities and vehicle movement over unpaved areas would be minimized by frequent watering or other dust-control measures. No substantial air-quality impacts associated with implementing the construction phase of the proposed action would be expected.

Operations

Natural gas (or propane)-fired boilers would be considered for space heating, humidification, or process steam needs (diesel fuel may be considered as a backup fuel). A closed-loop air-conditioning system would also be considered for heating and cooling. All boilers would employ state-of-the-art, clean-burning technology and therefore would not be expected to require supplemental emission controls. Diesel-fueled generators would provide electricity in the event of the loss of utility power. These generators would be required to employ Best Available Control Technology for emissions, including the use of low-sulfur fuel. Emissions of criteria pollutants from the PSF were estimated based on a comparison with the EMSL, a 19,000-m^2 (200,000-ft^2) laboratory facility similar in size and function to the PSF, which began operations in 1997. Based on a ratio of areas occupied by the two facilities, PSF space heating and backup generator maintenance and operation could be expected to release criteria pollutants at levels up to about 1.7 times those of the EMSL. Table 5.1 contains estimates of criteria pollutant release rates during operation of the PSF.

Table 5.1. Estimated Release Rates of Criteria Pollutants from the PSF

Criteria Pollutant[a]	Release in tons per year[b]
NO_2	1.7
CO	2.1
SO_2	0.015
THC (total hydrocarbons/VOC)[c]	0.57
Particulates (total)	0.14
PM_{10}	8.7E-04
Pb[d]	1.0E-05

(a) NO_2 = nitrogen dioxide; CO = carbon monoxide; SO_2 = sulfur dioxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 micrometers diameter; Pb = lead.
(b) To convert to tonnes multiply by 0.91.
(c) Includes 0.35 tpy VOC from laboratories. VOC are managed by application of best available technology rather than to a specific limit.
(d) Includes 3.4E-06 tpy of lead from laboratories.

Short-term increases in ambient air concentrations would be expected to result from fluctuations in the demand for boiler use for space heating, the use or testing of diesel-powered emergency electrical power generators, the use of diesel fuel in the boilers during an interruption in the natural gas supply, and changing meteorological conditions.

Table 5.2 shows the modeled air concentrations, reflecting both annual average and short-term air concentrations, and compares them to their respective National Ambient Air-Quality Standards (NAAQS). The calculations conservatively assume that the highest short-term emissions occur simultaneously with the worst-case meteorological conditions.

Table 5.2. Estimated Maximum Incremental Concentrations of Criteria Pollutants and Their Relation to National Ambient Air-Quality Standards

Criteria Pollutant[(a)]	Standard, $\mu g/m^3$	Averaging Times	Concentration in $\mu g/m^3$	Percent of Standard
CO	10000	8-hour	400	4
	40000	1-hour	1200	3
Pb	1.5	Quarterly	0.000003	0.0002
NO_2	100	Annual	0.06	0.06
PM_{10}	50	Annual	0.00003	0.0001
	150	24-hour	5.8	4
$PM_{2.5}$[(b)]	15	Annual	0.00003	0.0002
	65	24-hour	5.8	9
Sulfur Oxides	78	Annual	0.0005	0.001
	364	24-hour	4.4	1.2

(a) CO = carbon monoxide; NO_2 = nitrogen dioxide; PM_{10} = particulate matter less than 10 micrometers diameter; $PM_{2.5}$ = particulate matter less than 2.5 micrometers diameter; Pb = lead.
(b) Assumes release is same as for PM_{10}.

With the exception of volatile organic compounds (VOC) and lead, emissions of criteria pollutants from research activities would be expected to result in less than 4% of those from space heating and generator operation (Table 5.2). The laboratory emissions of VOCs and lead are incorporated into the results in Table 5.1 and the results from lead are shown in Table 5.2 (there are no quantitative National Air Quality Standards for VOC emissions). Based on these projections, releases of criteria pollutants from the PSF would not cause air-quality standards to be approached, and the area would continue to be in attainment with National Ambient Air-Quality Standards. The emissions of other laboratory chemicals are described in Section 5.1.12.2.

5.1.3 Water Quality

Potential impacts on surface and groundwater as a result of implementing the proposed action are described briefly as follows.

Surface Water

As noted in Section 4.4, there are no occurrences of surface water on the PNNL Site. Stormwater at the PSF would be collected and distributed in a series of infiltration trenches, drains, and catch basins (regulated as injection wells under the Washington Administrative Code, WAC 173-218), and no permanent impoundments would be expected. If required, the storm water management system would be registered with the Washington State Department of Ecology, and would incorporate Best Management Practices as specified by Ecology for commercial facilities of comparable size. Sanitary and process wastewater would be disposed of to the City of Richland sanitary sewer system under a City of Richland Industrial Wastewater Discharge Permit and would be similar to discharges from other PNNL facilities. Further discussion of liquid wastes is presented in Section 5.1.11, Waste Generation and Disposition.

Groundwater

Use of groundwater to heat and cool the PSF is being considered. The required flows, effectiveness, and cost of such a system would be evaluated during detailed design of the facility. In one possible configuration, the system would pump groundwater through a closed-loop heat exchanger, in which case only heat would be added to groundwater. Since there are no down-gradient uses of groundwater, either ongoing or planned, there would be minimal impact from using this heating/cooling configuration. In another possible configuration, the system would pump groundwater through a heat exchanger and return it to groundwater. The concentration of nitrate in groundwater beneath the PSF construction site currently exceeds drinking water limits; however, the return of water would be regulated to avoid increasing that concentration; thus, there would be minimal incremental impact on groundwater from the heating/cooling system. No releases of process water that would cause impacts to groundwater quality are planned or expected.

As noted above, stormwater would be collected and distributed to a series of infiltration drains, trenches, and catch basins and would constitute the only discharge potentially reaching groundwater. Water consumption and evapo-transpiration by foliage and vegetation used in landscaping would be expected to closely balance natural recharge and seasonal irrigation with no adverse consequences for groundwater.

Based on the above information, impacts on water quality from implementing the proposed action would be expected to be minimal.

5.1.4 Geological Resources

No impacts would be expected on geological resources, which consist principally of Rupert Sand and Burbank Loamy Sand, underlain by Ice Age Flood gravels, which are locally abundant. These soils are not considered “prime farmland” in this semi-arid climate. Although they might be suitable for some crops if irrigated, no water rights are in place that would permit agricultural use on the PNNL Site. It is anticipated that soil removed during excavations for footings, foundations, and basements would be used in landscaping.

5.1.5 Cultural and Historical Resources

As described in Section 4.5, a historic segment of an early 20th century irrigation canal liner and minor trash litters were identified on the PNNL Site. No other resources of possible cultural or historical interest were found.

With respect to the historic canal liner segment, PNSO entered into an agreement with the SHPO in 2005 to address protective requirements as follows (see Appendix A):

- PNSO will prepare thorough documentation of the canal (Site H3-21) prior to project implementation.
- PNSO shall work with a local historical organization to prepare interpretive materials on the Canal in consultation with the SHPO.
- PNSO will attempt to retain in place Canal Segment 1 and incorporate it into the general landscaping until such time as the area is needed for other purposes.

The fenced area within the eastern portion of the buffer area is of cultural significance to regional Tribes and aside from maintenance of fencing, the area would remain undisturbed. The opportunities for Tribal access to that area would remain unchanged.

There would be no constraints resulting from construction and operation of the PSF on fishing rights, or on the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land, as secured for the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe in their respective 1855 treaties with the United States.

As a protective measure for unknown cultural resources, archaeologists would monitor excavations as appropriate, and site construction workers would be instructed to watch for artifacts. If artifacts of potential significance were found, work would stop, and the designated archaeological monitor would be notified (Appendix A).

5.1.6 Biological Resources

Potential impacts of PSF construction on habitats and species within the PNNL Site, as described in Section 4.6 and Appendix B, are summarized in this section. Construction of the PSF, including equipment staging and laydown areas, access roads, and subsequent landscaping to reduce the threat of wildfire, would disturb the majority of the natural vegetative cover within the PNNL Site. Any remaining natural habitat would be of limited utility to many of the biota that currently occupy the site (see Section 4) because of its greatly reduced size and separation from similar areas.

Construction in the portion of the site south of the Richland Irrigation Canal would disturb habitat occupied primarily by alien annual weedy plant species. Construction in the portion of the site north of the Richland Irrigation Canal would disturb primarily mature shrub-steppe habitat. Shrub-steppe is considered a priority habitat in the state of Washington (WDFW 2004) because of its relative scarcity in the state and its value for many wildlife species. If the entire PNNL Site north of Horn Rapids Road were developed, it would result in the loss of approximately 26 ha (64 ac) of mature shrub-steppe, mostly in the area north of the Richland Irrigation Canal. Construction would likely destroy wildlife with limited mobility, such as small mammals, while other more mobile animals, such as large mammals and birds, would likely be displaced into areas to the west, north, and east of the construction site.

Because of uncertainty concerning the presence of some species of birds, DOE would not initiate construction activities on an undisturbed site during the nesting season (March 1 through July 31), which could destroy nests of ground- and shrub-nesting bird species described in Section 4. These might include species protected under the *Migratory Bird Treaty Act* (16 USC 703-712) and could possibly include federal species of concern and Washington State candidate species, such as burrowing owls (*Athene cunicularia*), sage sparrows (*Amphispiza belli*), and loggerhead shrikes (*Lanius ludovicianus*).

5.1.7 Impacts on Floodplains and/or Wetlands

The PNNL Site is above the elevation for the probable maximum flood (DOE 1999, page 4-33); hence, it is not in a floodplain within the meaning of Executive Order No. 11988 (42 FR 26951), nor is it a wetland. As a consequence, there would be no impacts on floodplains or wetlands associated with implementing the proposed action.

5.1.8 Traffic and Transportation

Potential impacts on traffic and transportation associated with construction and operation of the proposed PSF are described in the following sections:

Construction

For purposes of this analysis, it was estimated that there would be an average of about 250 construction workers employed over a 2-year period and that there would be a peak force of about 450 workers. In a phased construction, the overall impacts as described in this section would be similar, but the peak work force may be somewhat smaller and the activities would occur over a longer period of time. The materials to be used in construction were estimated at about 11,000 m^3 (15,000 yds^3) of concrete, 1,000 tonnes (1,100 tons) of structural steel, 20,000 L (5,200 gal) of gasoline, and about 4,500 L (1,200 gal) of diesel fuel.

Peak hourly traffic rates on George Washington Way and Stevens Drive, as measured at Horn Rapids Road, are 340 and 1,600 vehicles, respectively (City of Richland 2006a). Currently traffic on the two-lane Horn Rapids Road is minimal. At the height of construction, there might be as many as 450 additional vehicles going to the PSF construction site. Assuming the construction traffic would be distributed between those two major routes as above, the traffic counts could increase to approximately 420 and 1970, respectively. This increase would not substantially impact traffic on the major 4- to 6-lane routes.

Accident impacts were estimated for transporting construction materials to the PSF construction site using state-specific accident statistics. Accidents, injuries, and fatalities from traffic accidents involving construction materials were estimated using heavy-combination truck accident statistics presented in Saricks and Tompkins (1999). In that document, the composite accident, injury, and fatality rates for all road types in the State of Washington were 2.05E-07 accidents/truck-km, 1.4E-07 injuries/truck-km, and 5.3E-09 fatalities/truck-km. It was assumed that concrete is transported from local offsite suppliers. The transport distance was assumed to be no more than 48 km (30 mi) one-way, which would encompass most potential suppliers in the Tri-Cities region. Structural steel was also assumed to be transported from an offsite vendor. Since the specific vendor has not been identified, it was conservatively assumed that the steel would be transported about 1,000 km (600 mi) one-way to the PSF construction site, which would encompass most potential steel suppliers in the northwestern region of the United States. Typical shipments carry about 10 tons of steel per truckload. Gasoline and diesel requirements are less than one truck shipment over the 2-year period. Although the origins for gasoline and diesel fuel shipments are also unknown at this time, it was assumed that the farthest potential vendor would be in the Seattle area, and a one-way shipping distance of 400 km (250 mi) was assumed. The estimated traffic accident impacts for construction materials are shown in Table 5.3.

As shown in the table, no traffic accidents, injuries, or fatalities would be expected from transporting construction materials to the PSF construction site.

Table 5.3. Impacts Associated with Transport of PSF Construction Materials

Material	Total Material	Shipment Capacity	Total Ship-ments	One-way Distance, km	Total Distance, km	Accidents	Injuries	Fatalities
Steel (MT)	1,100	10 MT	110	1,000	2.2E+05	0 (4.5E-02)	0 (3.1E-02)	0 (1.2E-03)
Concrete (1000 m^3)	15	10 m^3	1,500	48	1.4E+05	0 (3.0E-02)	0 (2.0E-02)	0 (7.6E-04)
Diesel (gal)	1,200	>1200	1	400	8.0E+02	0 (1.6E-04)	0 (1.1E-04)	0 (4.2E-06)
Gasoline (gal)	5,200	>5200	1	400	8.0E+02	0 (1.6E-04)	0 (1.1E-04)	0 (4.2E-06)
Total					3.6E+05	0 (7.5E-02)	0 (5.1E-02)	0 (1.9E-03)

The impacts of traffic accidents involving workers traveling to and from the PSF construction site were calculated using traffic-accident statistics for the South-Central Region of Washington State compiled by the Washington State Department of Transportation (2006). This document gives the accident, injury, and fatality rates for all roads in this region to be 5.7E-07 accident/km, 2.0E-07 injuries/km, and 7.5E-09 fatalities/km, respectively. It was assumed that 250 workers per day would travel an average distance of 20 km (12 mi) one-way to the PSF construction site. This distance encompasses most of the Tri-Cities region, and it accounts for the fact that most of the workers would travel a shorter distance and that many are likely to car-pool. Assuming each worker makes the trip 250 days per year for 2 years, the total distance traveled would be about 5 million km (3 million mi). The impacts in terms of accidents, injuries, and fatalities are shown in Table 5.4.

Table 5.4. Impacts Associated with PSF Construction Traffic

No. of Workers	Trips/day	Avg. Distance km	Days/yr	No of Years	Total distance km	Accidents	Injuries	Fatalities
250	2	20	250	2	5.0E+06	3 (2.8E+00)	1 (9.9E-01)	0 (3.7E-02)

As shown in the table, there may be 2 to 3 traffic accidents involving workers commuting to the PSF construction site during the construction period, involving perhaps 1 injury and no expected fatalities.

Operations

At such time as the Shielded Operations module becomes operational, George Washington Way would be closed to through traffic north of Horn Rapids Road. The majority of the present peak hourly rate of 340 northbound vehicles on George Washington Way was assumed to carry 300 Area PNNL workers who would work at the PSF when completed. As a result, a small number of vehicles representing current through traffic to the 300 Area and beyond would be rerouted on to Stevens Drive at Horn Rapids Road, or alternatively, on another existing cross street connecting George Washington Way and Stevens Drive.

The number of workers and supplies needed to conduct physical research and the amount of waste to be transported would not likely be substantially different whether the research is conducted in the 300 Area or in the proposed PSF. Present 300 Area activities associated with PNNL research and development are not a substantial part of overall traffic or transportation on Stevens Drive or George Washington Way. Using the same assumptions as for the commute of construction workers, about 2 accidents involving 1 injury and no fatalities might be expected per year among the 480 PSF workers. Thus, implementation of the proposed action would be expected to have minimal impacts on traffic and transportation accidents.

Materials to be transported to the PSF and waste from DOE and other government agency projects to be transported from the PSF would be less than the materials and waste being transported from R&D activities moving to and from the 300 Area at present.

It is concluded that impacts from transport of personnel, materials, and waste associated with the construction and operation of the PSF would be minimal.

5.1.9 Socioeconomics

Anticipated impacts on socioeconomics associated with construction and operation from implementing the proposed action are described as follows:

Construction

For purposes of this analysis, it was assumed that about 250 construction workers would be needed over a 24-month period, with a peak force of about 450 workers. In a phased construction, the overall impacts as described in this section would be similar, but the peak work force may be somewhat smaller and the activities would occur over a longer period of time. Even if the peak workforce were recruited from other areas, the increase in the DOE and contractor workforce consisting of about 14,000 members (2004 data) would amount to about 3%. Total non-agricultural employment in Benton and Franklin Counties is over 100,000 people (Schau 2006), so even if construction creates additional service sector jobs, the total increase in employment likely would be well under 1% of the current employment level. Increases of less than 5% of an existing labor force have been determined to have little effect on an existing community (DHUD 1976).

Operations

As noted for transportation impacts during operations, the number of workers needed for R&D activities in the PSF is expected to be similar to that for research currently conducted in the 300 Area, because the PSF would be constructed to relocate existing PNNL staff. As a consequence, no impacts on socioeconomics or community infrastructure would be expected from operations associated with implementing the proposed action.

5.1.10 Resource Commitments

Construction

The quantities of concrete, steel, diesel fuel, gasoline, and propane committed to implementation of the proposed action would be typical of that required for a 31,000-m^2 (332,000-ft^2) facility and associated landscaping. Preliminary estimates include about 11,000 m^3 (15,000 yd^3) of concrete, 1,100 tonnes

(1,000 tons) of structural steel, 20,000 L (5,200 gal) of gasoline, and about 4,500 L (1,200 gal) of diesel fuel. None of these resources are unique or regionally in short supply. Minimal impact would be expected as a result of commitment of these resources for the PSF.

Operations

Power requirements for the PSF operations have been estimated at 5 megawatts (MW), whereas power requirements for the 300 Area from 1998 to 2007 were estimated to be about 12 MW (DynCorp 1997). The City of Richland has 316 MW electrical-power capacity of which about 139 MW is not used (City of Richland 2005b). Electrical requirements for the PSF would represent about 4% of the unused power capacity, and would have minimal impact on electrical power supply.

An average of about 640 L per year (230 gal per year) of diesel fuel would be used for boilers and emergency electrical power generators. About 770,000 m^3 per year (27 million ft^3 per year) of natural gas at standard temperature and pressure (STP) would be consumed for humidification and supply of process steam needs, and for boilers used in space heating in the event that a closed-loop air conditioning system were not employed. Minimal impact would be expected as a result of commitment of these resources for the PSF. (U.S. production of natural gas is about 20,000,000 million ft^3 per year.)

Potable water consumption for the PSF is estimated as 3.8E-04 ML/d (100 gpd) per person (EPA 2004) for 480 people, or 0.18ML/d (4.8E+04 gpd), and 0.12ML/d (3.2E+04 gpd) of process water, for a total of about 0.3 ML/d (0.08 Mgpd). The current average production of the Richland Municipal Water Plant is about 72 ML/d (19 Mgpd), and the capacity is about 140 ML/d (36 Mgpd). Thus, PSF requirements would amount to about 0.5% of the difference between current demand and design capacity, which would have minimal impacts on the local supply of potable water (City of Richland 2005b).

Irrigation of the PSF landscaping would require about 3.5 ac-ft/ac-yr of water, with a peak of about 0.9 ac-ft/ac-mo during July (after USDA 1997, *WA Irrigation Guide, Appendix A*, turf). The present estimated area requiring irrigation is 13 ha (36 ac) for which the annual water requirement would be about 150,000 m^3 (125 ac-ft) and peak monthly usage (during July) would amount to 40,000 m^3 (32 ac-ft). The source for this water has not been identified, but if purchased from the City of Richland, the peak demand on the water plant would be about 4 ML/d (1 Mgpd). That quantity represents about 6% of the difference between current demand and the plant design capacity, from which it is concluded that impacts from use of City of Richland water would be minimal.

5.1.11 Waste Generation and Disposition

DOE is implementing Executive Order 13123 (64 FR 30851), *Greening the Government Through Efficient Energy Management*, Executive Order 13148 (65 FR 24595) *Greening the Government Through Leadership in Environmental Management,* and associated DOE Orders or guidelines, by reducing toxic chemical use and encouraging the development and use of clean and energy-efficient technologies. Program components include waste minimization, recycling, source reduction, energy-efficient building construction, and buying practices that give preference to products made from recycled materials. Waste management activities associated with the construction and operation of the PSF would be conducted in accordance with this program. Implementation of the pollution prevention and waste minimization programs would also minimize the generation of secondary wastes.

Most construction wastes would be recycled; however, about 800 m^3 (1,000 yd^3) might be disposed of in the City of Richland sanitary landfill. The City of Richland notes that with its 46-ha (114-ac) landfill, it has the capacity to accommodate municipal wastes for the next 50 years (City of Richland 2004a). That area, with a nominal trench depth of 15 m (50 ft), amounts to about 7,000,000 m^3 (8,000,000 yd^3). Based on the available capacity, it is concluded that PSF construction wastes would have minimal impact on municipal disposal facilities.

Quantities of wastes generated in support of R&D operations at the PSF would be similar to, but unlikely to exceed, those from ongoing PNNL R&D activities in the 300 Area. Based on past experience, the types of waste would include low-level radioactive waste, transuranic waste, mixed (hazardous and radioactive) low-level waste, and hazardous (non-radioactive) waste, in addition to the non-hazardous solid wastes typically associated with operation of any industrial or laboratory facility. Based on the 2005 experience, the amounts of those wastes to be produced annually by operations in the PSF were forecasted to be approximately 160 m^3 (210 yd^3) of low-level radioactive waste, 7 m^3 (9 yd^3) of transuranic waste, 7 m^3 (9 yd^3) of mixed low-level waste, and 13 m^3 (17 yd^3) of hazardous (non-radioactive) waste. The forecasted amounts of low-level radioactive waste (non-compacted) from PSF operations would amount to about 8% of the forecasted total Hanford Site generation rate (from Hanford Site and other government agency wastes) over the assumed 30 years of operation. Similarly, PSF transuranic waste would amount to about 2%, and PSF mixed low-level waste would amount to about 1%, of the corresponding Hanford Site totals. Hazardous non-radioactive waste would be sent to a permitted commercial disposal facility. Because these quantities are comparable to the wastes currently being generated at 300 Area laboratory facilities occupied by PNNL, it is expected that low-level and mixed wastes could be managed within the capacity of existing Hanford Site disposal facilities. Transuranic waste would ultimately be disposed of at the Waste Isolation Pilot Plant in New Mexico.

Liquid wastes would consist of waste process water and sanitary sewage. Both of these wastes would be sent to the City of Richland's Publicly Owned Treatment Works (POTW) for processing. Process water generated as a part of facility operations would be monitored to verify compliance with permitted pollutant concentrations as shown in Table 5.5.

Table 5.5. Local Limits for the City of Richland Publicly Owned Treatment Works (from the City of Richland 2004b; Pretreatment Program, Title 17.30, Exhibit A, October 5, 2004)

Constituent	Limit
pH	>5.0 - < 10
Arsenic	0.10 mg/L
Cadmium	0.32 mg/L
Chromium	1.74 mg/L
Copper	1.30 mg/L
Cyanide	0.22 mg/L
Lead	0.37 mg/L
Mercury	0.02 mg/L
Molybdenum	0.07 mg/L
Nickel	2.32 mg/L
Selenium	0.04 mg/L
Silver	0.20 mg/L
Zinc	10.4 mg/L
Polar/nonpolar fats, oil, and grease	100 mg/L

The volumes of these wastes would be about 0.12 ML/d (3.2E+04 gpd) for process water and 3.8E-04 ML/d (100 gpd) per person for 480 people, or 0.18 ML/d (4.8E+04 gpd), for sanitary sewage, assuming it to be equal to the potable water consumption by PSF staff (EPA 2004). The total to the POTW would amount to about 0.3 ML/d (0.08 Mgpd). The average flow of the POTW is 34 ML/d (8.9 Mgpd) with a design flow of 43 ML/d (11.4 Mgpd), and it can accommodate a peak flow of 92 ML/d (24 Mgpd). The estimated PSF requirement represents about 3% of the difference between average flow and design flow, and would be expected to have minimal impact on POTW operations (City of Richland 2006b).

5.1.12 Human Health and Safety

Impacts on health and safety from construction and operation of the proposed PSF are presented in this section. Impacts related to radiological exposures, chemical exposures, and workplace activities are discussed in Sections 5.1.12.1, 5.1.12.2 and 5.1.12.3, respectively.

5.1.12.1 Radiological Impacts

Anticipated impacts on health and safety of both workers and the public from exposure to radiation and radioactive materials for routine operations and accident conditions at the PSF are discussed in this section.

Routine Operations

Anticipated impacts of routine operations at the PSF on the health and safety of both workers and the public for radiological exposures and for routine activities are discussed in the following section.

Radiological impacts are based on historical experience with the 300 Area laboratories at the Hanford Site where PNNL conducts R&D activities that would be transferred to the PSF. That experience is expected to bound estimates of impacts that might result from operating the PSF because the 300 Area laboratory operations include the RPL, which is a Nuclear Hazard Category 2 facility (DOE 1997) with a larger permitted threshold of radioactive material than the Hazard Category 3 Shielded Operations module of the PSF. Because work in the PSF would involve smaller quantities of radioactive materials than activities currently being conducted in 300 Area laboratories occupied by PNNL, worker exposure to radiation and other hazardous materials would be expected to be similar to, or lower than, recent exposure levels based on handling of existing inventories. The PSF would be located about 1.6 km (1 mi) south of the 300 Area where prevailing winds would be essentially the same as at the 300 Area meteorology station.

Estimates of human health consequences following exposure to ionizing radiation are expressed in terms of probability of latent cancer fatality (LCF) for individuals or number of LCFs for populations, and are based on a dose-to-LCF factor of 0.0006 LCF per person-rem for both workers and the public (ISCORS 2002). Consequences for populations are also expressed as risk of LCF in the population, accounting for the estimated frequency of an event that results in exposure of the population to radiation. In estimating the risk from accidents, the frequency of an event is usually designated by a range and is characterized as either Anticipated (frequency ranging from 1 in 100 to 1.0 per year), Unlikely (frequency ranging from 1 in 10,000 to 1 in 100 per year), or Extremely Unlikely (frequency ranging from 1 in 1,000,000 to 1 in 10,000 per year). Events expected to occur with a frequency lower than 1 in 1,000,000 per year are not considered for purposes of safety analysis. For routine activities or exposure of populations to background radiation, the estimated frequency of the exposure is assumed to be 1.0.

Workers − Radiological impacts on worker health and safety from PSF operations were estimated to be bounded based on 5 years of recent experience from PNNL R&D activities, which are representative of activities that would be conducted in the PSF. Worker doses over the 5-year period from 2001 to 2005 are presented in Table 5.6 (DOE 2006b).

Table 5.6. Worker Doses from PNNL Research and Development Activities

	Number of workers with measured doses by category, mrem							Total Worker
Year	**Not Measurable**	**Less than 100**	**100 to 250**	**250 to 500**	**500 to 750**	**750 to 1000**	**1000 to 2000**	**Collective Dose, person-rem**
2001	544	116	16	8	2	0	0	11
2002	527	125	12	11	2	2	0	12
2003	546	106	18	6	5	4	0	15
2004	563	90	21	7	4	0	0	11
2005	608	87	16	9	4	2	0	13

At the dose levels presented in Table 5.6, the inferred probability of an LCF for the maximally exposed worker over a 30-year career (at 1 rem/yr) would be 0.02, with no (0.3) inferred LCFs for the worker population as a whole. For perspective, 4 LCFs would be inferred to occur among this work force from naturally occurring sources of radiation during this same period.

Public − Based on results calculated from releases of radioactive materials to air from 300 Area facilities, as presented in the Hanford Site Environmental Report for 2005 (Poston et al. 2006) and prior years, the dose (exclusive of background) to the maximally exposed individual in the public would be expected to be less than 0.021 mrem/yr, which represents the maximum from PNNL operations in the 300 Area over the past 15 years (Poston et al. 2006). If an individual were to be exposed for 30 years at that level, the total dose would amount to about 0.6 mrem, from which the probability of LCF would be 4E-07. For perspective, that individual would have received 9,000 mrem from background radiation, from which the probability of LCF would be about 0.005.

The collective dose to the population out to 80 km (50 mi) based on the average annual population dose for the 5-year period 2001 to 2005 (Poston et al. 2006) would amount to about 0.19 person-rem per year. Moving the source from the 300 Area to the PSF about 1.6 km (1 mi) to the south would increase the population dose by about 50%, or to about 0.29 person-rem per year.(13) Assuming a 30-year period of operation and a constant population, the total collective dose would be about 9 person-rem, for which no LCFs (0.005) would be expected.

(13) For this analysis, the population distribution was assumed to be moved 1.6 km (1 mi) north, and the resulting population dose was calculated for a unit release of Pu-239. The ratio of that dose to the population dose for unit release from the 300 Area was 1.5.

Accident Conditions

Operations. The boundary (point of unrestricted public access) for the PNNL Site and buffer area would be at least 400 m from possible points of release of radionuclides in the PSF Shielded Operations module (Figure 5.1). As discussed in Section 3.1, radioactive material inventories within the PSF Shielded Operations module would be maintained within DOE (1997) Nuclear Hazard Category 3 limits, and the inventories of dispersible materials actually present in the facility are expected to be well below those limits, as evidenced by the representative inventories listed in Table 3.1.

To examine potential impacts of accidents occurring at the PSF on workers and the public, the consequences of a hypothetical accident involving the PSF Shielded Operations module were determined for a combination of Pu-239 equivalent and H-3 equivalent involved in an explosion or fire. Assuming that all protective barriers were breached, an explosion or fire involving dispersible material at the Shielded Operations module yielded the largest consequences from among postulated accidents considered for the PSF.

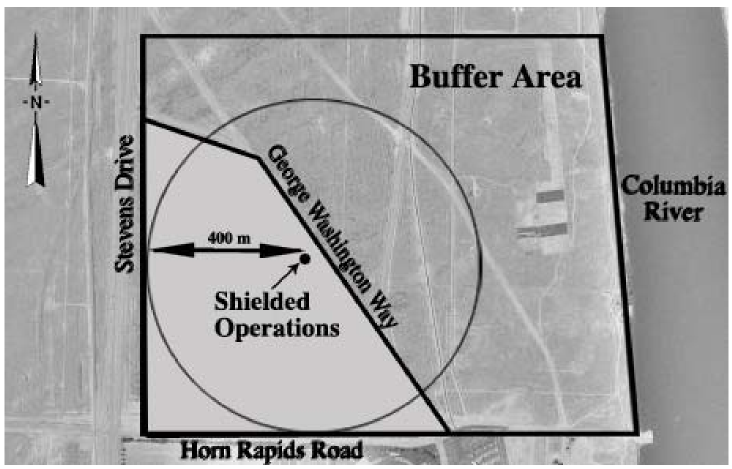

Figure 5.1. Approximate Location of Shielded Operations Within the Proposed Construction Site

As an example, Table 5.7 lists the combined inventories of Pu-239 equivalent and H-3 equivalent that would result in a maximum potential dose of 1 rem to a hypothetical member of the public at the site boundary following a fire or explosion at the Shielded Operations module. Based on airborne release fractions in DOE (1994), an event involving 43 Ci Pu-239 equivalent in the facility would result in a release to the environment of about 0.086 Ci Pu-239 equivalent at a height of 10 m (33 ft). For combined releases of Pu-239 equivalent and H-3 equivalent, 100% of the facility H-3 inventory was assumed to be released in the event. The frequency of such an event was estimated as between 1 in 10,000 to 1 in 1,000,000 per year, and would be considered Extremely Unlikely. The consequences of the postulated event would be expected to be essentially the same whether they result from a process accident or from some other initiator, such as a seismic event or an intentional destructive act.

Table 5.7. Combined Inventories of Pu-239 Equivalent and H-3 Equivalent in the Shielded Operations Module that Would Result in a Maximum Potential Dose of 1 Rem at the PNNL Site Boundary Following a Fire or Explosion

Plutonium-239 Equivalent (Pu-239E) Inventory, Ci	Tritium Equivalent (H-3E) Inventory, Ci
43	0
33	12,000
23	24,000
13	36,000
3	48,000

Workers. The fire or explosion could be fatal for the involved workers in the room where the event began, and serious injuries might occur among nearby workers in other parts of the building. The non-involved worker was postulated to be located 100 m (~300 ft) distant and was calculated to receive 5 rem, which would not be expected to have any acute physical impacts, but for which the probability of developing an LCF would be 0.003.

Public. As noted previously, the dose from the accident to an individual at the nearest point of public access (400 m distant from possible release points) would not exceed 1 rem based on an inventory of 43 Ci Pu-239 equivalent in the Shielded Operations module. The probability of developing an LCF would be about 0.0006 from such a dose.

The point of maximum potential dose for a residential area is about 1.2 km (0.8 mi) distant, at which location, the lifetime dose to a resident would be about 0.4 rem. The corresponding probability of LCF would be about 0.0002 for a member of the public. The lifetime dose to an individual in the vicinity of WSU-TC and Hanford High School, about 3 km (1.8 mi) from the PSF, would be about 0.2 rem, resulting in a 0.0001 probability of LCF. For perspective, the average annual dose from naturally occurring radiation sources is about 0.3 rem.

The collective dose as calculated using the GENII code[(14)] (Napier et al. 1988) would amount to about 1,500 person-rem for the population sector with the highest consequences following plume passage (using 95th percentile meteorological conditions), namely, the 22.5-degree sector centered due south of the PSF out to 80 km (50 mi), which encompasses a population of 69,342 (Elliott et al. 2004).[(15)] One LCF might be inferred as a result of the accident, if it occurred. Accounting for the estimated event frequency and a 30-year operating life for the facility, the risk from that accident would range from about 0.00003 to 0.003 LCFs. For perspective, about 400 LCFs would be estimated for the same population and time period from background radiation sources.

(14) As adjusted, using ICRP 72 (ICRP 1995) inhalation dose factors versus ICRP 30 (ICRP 1979-1988) inhalation dose factors.
(15) This sector includes a large portion of the City of Richland and the area surrounding Umatilla and Hermiston, Oregon.

Another accident was considered that involved a spill of dispersible radioactive material. Based on airborne release fractions in DOE (1994), that event would release about 0.026 Ci Pu-239 equivalent. The probability of that event was estimated as 1 in 100 to 1 in 10,000 per year, placing it in the Unlikely category. The collective dose from this spill would be about 450 person-rem and the 30-year LCF risk would range from about 0.0008 to 0.08 LCFs. Thus, although the release of radioactive material from the spill would be smaller than that from the fire or explosion, the LCF risk over 30 years of operation would be greater because of the higher estimated frequency of the spill event. However, neither acute effects nor LCFs would be expected from either event for 30 years of PSF operation.

5.1.12.2 Chemical Impacts

Anticipated impacts on health and safety of both workers and the public from exposure to non-radioactive hazardous chemicals for routine operations and accident conditions at the PSF are considered in this section. Appendix C contains a listing of inventories for the most frequently used chemicals, as well as information supporting the chemical impact analyses.

Chemical use in the PSF would be similar to existing uses in the 300 Area facilities occupied by PNNL, and relatively small quantities would be released to the environment (Woodruff et al. 2000). Work is performed in laboratories designed for safe use of chemicals, including equipment such as ventilation-controlled fume hoods and worker protective clothing. The Washington State Department of Ecology regulates the emissions of 580 chemicals under WAC 173-460 Controls for New Sources of Toxic Air Pollutants. The anticipated emissions of those chemicals from the PSF were estimated, and their concentrations were calculated for the points of nearest potential public exposure using the EPA Industrial Source Complex dispersion model. The results are presented in Table 5.8, which shows the annual average and 24-hour average ambient air concentration for the 20 toxic air pollutants that were the highest percent of their respective health-risk based Acceptable Source Impact Levels (ASILs) as listed in that regulation. Based on the small percentages of ASILs estimated, and the fact that the sum of fractions for all the air toxic pollutants to be used in PSF is less than one, it is concluded that impacts on public health from the release of chemicals from routine operations would be minimal.

There is insufficient evidence for accidental exposure of workers or members of the public to hazardous chemicals at PNNL laboratory facilities over the last 10 years of operations to form a quantitative basis for estimating impacts from accidents involving hazardous chemicals at the PSF.[16] However, the lack of reportable events within all of PNNL over a recent 10-year period indicates that the potential impacts from use of hazardous chemicals would be minimal for those activities that would be relocated to the PSF.

(16) A single case of injury to one worker was found in which a flexible tubing line for transfer of hazardous/radioactive waste failed, spraying two workers; one worker experienced first-degree chemical burns on his face and arms as a result.

Table 5.8. Estimated Concentrations of PSF Laboratory Toxic Air Pollutant Emissions

Chemical	Ambient Air Concentrations		
	Annual Average, μg/m^3	24-Hour Average, μg/m^3	Percent of Acceptable Source Impact Level (ASIL)
Hydrogen Chloride	2.4E-04	1.0E-01	1.42
Chlorodifluoromethane	2.1E-02	8.7E+00	0.73
Lead Compounds	6.8E-06	2.9E-03	0.58
Diborane	4.4E-06	1.9E-03	0.50
Polyaromatic Hydrocarbons	2.7E-09	1.1E-06	0.24
Chloroform	7.8E-05	3.3E-02	0.18
Phosphine	5.4E-06	2.3E-03	0.18
Nitrogen Trifluoride	4.0E-04	1.7E-01	0.17
Ammonia	3.7E-04	1.5E-01	0.15
Acrylic Acid	7.2E-07	3.0E-04	0.10
Methylene Chloride	5.3E-04	2.2E-01	0.10
Boron Trifluoride	1.7E-05	7.1E-03	0.08
1,2-Epoxybutane	2.5E-05	1.1E-02	0.05
Toluene	4.4E-04	1.9E-01	0.05
Vinyl Chloride	4.3E-06	1.8E-03	0.04
Trichloroethylene	1.9E-04	8.1E-02	0.03
Chromium	2.2E-08	9.3E-06	0.03
Nitric Acid	1.0E-05	4.3E-03	0.03
Carbon Tetrachloride	1.7E-05	7.1E-03	0.03
Hexafluoroacetone	1.3E-06	5.3E-04	0.02

5.1.12.3 Physical Impacts

Construction. Construction of the PSF would require about 1,000,000 labor-hours, and the total labor requirement is expected to be similar whether the facility is constructed as a single project or in phases over a longer period. Based on DOE contractor/subcontractor construction experience of 1.8 cases of injury/illness per 200,000 labor-hours during 2002 to 2005 (DOE 2006a), about 9 cases of injury/illness might occur during construction of the PSF.

Operations. Based on a 480-person work force, working 8 hours per day and 250 days per year, the annual labor for PSF operations would amount to 960,000 labor-hours. With the PNNL average incidence of 1.4 cases of injury/illness per 200,000 labor-hours (Section 4.10), about 7 such cases might be expected per year.

5.1.13 Noise Impacts

Construction activities would generate noise typical of using heavy equipment (modeled here as simultaneous use of two 300-HP diesel-fueled bulldozers) and transport of materials. Noise impacts are assessed by establishing regions of influence for residential, commercial, and industrial receptors and are presented briefly as follows.

The nearest residential area to the construction site would be the WillowPointe housing development (under construction) located about 0.8 km (0.5 mi) southeast. The Washington State Noise regulation (WAC 173-60) limits daytime noise to 60 dBA for residential locations. WillowPointe housing would be well outside the "residential region of influence," which extends to 0.32 km (0.2 mi) from the construction site.

The "commercial region of influence" limit of 65 dBA would apply to facilities within 210 m (700 ft) of the construction site, including PNNL's EMSL and Information Sciences Building-I. Attenuation of noise by the buildings' walls and windows would reduce inside noise levels, although episodic noise events or associated ground vibrations might disturb the occupants.

All industrial receptors would be located well beyond the 130-m (400-ft) "industrial region of influence," in which noise levels are limited to 70 dBA.

Ground vibrations from using heavy equipment might have some impact on operation of the Laser Interferometer Gravitational-Wave Observatory (LIGO), located about 15 km (~9 mi) northwest of the PNNL Site. Notice to the LIGO operators of periods of heavy equipment usage would be considered so that operators could take the extraneous ground vibrations from construction into account.

After construction is completed, routine operations at the PSF would not be expected to increase noise levels over current ambient external background levels.

5.1.14 Environmental Justice

Operational impacts of the PSF are expected to be similar to, or lower than, those from ongoing PNNL R&D activities in the 300 Area. Currently, there are no impacts associated with 300 Area PNNL operations that could be reasonably determined to affect any member of the public; therefore, PSF operations would not have the potential for high and disproportionate adverse impacts on minority or low-income groups as defined in Section 4.8.

5.1.15 Cumulative Impacts

Cumulative impacts that might be associated with implementing the proposed construction and operation of the PSF are summarized in this section.

In 40 CFR 1508.7, the Council on Environmental Quality (CEQ) defines cumulative impact as:

> …the impact on the environment from the incremental impact of the action when added to other past, present, and reasonably future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

However, CEQ cautioned that, "The continuing challenge of cumulative effects analysis is to focus on important cumulative issues…" (CEQ 1997).

Based on the results of analyses presented in the previous sections, impacts in all resource areas were projected to be minimal. Historically, potential radiological impacts on human health and safety have been the environmental impact of most interest to the public, and thus they are considered in terms of cumulative impacts. The area of most probable influence associated with operation of the PSF would consist principally of the northern portion of the City of Richland and the rural area of Franklin County in an easterly direction across the Columbia River from the PSF.

The past Hanford Site activities that had the largest impact on the area of interest were the operation of the fuel fabrication facilities, production reactors, separations and product finishing plants, and R&D facilities employed on the site in support of national defense programs. Environmental impacts manifested themselves principally as a result of the release of radioactive material to air, water, and ground that occurred during production of nuclear materials for national defense during World War II and the following Cold War era.

Ongoing or planned actions that might also have a radiological or non-radiological impact on the same area of interest would include those associated with the following operations:

- CERCLA remediation projects, including cleanup of the 618-10 and 618-11 burial ground sites and the 300 Area, and remediation of the river corridor in the southeastern portion of the Hanford Site

- ongoing waste management and cleanup of the Hanford Site in general

- the Columbia Generating Station, a nuclear power plant located north of the 300 Area and operated by Energy Northwest.

The following ongoing operations located west to southwest of the proposed construction site might also have an impact on the area of interest:

- a nuclear fuel fabrication plant operated by AREVA (radiological)

- AMEC Geo Melt Test Site (pilot tests of bulk waste vitrification)

- Cold Test Facility (non-radiological testing of vitrification processes)

- Pacific EcoSolutions (a waste management company – formerly Allied Technology Group) (radiological)

- Ferguson Distribution Center (commodity distribution)

- International Hearth Melting (titanium-zirconium processing center)

- Meyer Plastics (industrial plastics producer).

Other activities in progress or presently planned in the neighborhood of the PSF (whether radiological or not) include:

- operation of the Bioproducts, Sciences, and Engineering Laboratory (under construction), a joint WSU and PNNL project located on the WSU-Tri-Cities campus

- construction and operation of a proposed Biological Science Facility, a privately funded facility to be leased by PNNL for biological and nuclear magnetic resonance research

- construction and operation of a proposed Computational Sciences Facility, a privately funded facility to be leased by PNNL

- construction and operation of a proposed Life Sciences Building, a Battelle-owned facility to support analytical and vivarium capabilities.

As indicated earlier, the historical 15-year maximum annual dose to the maximally exposed individual from 300 Area operations would be about 0.021 mrem (Poston et al. 2006). In 2005, the cumulative annual contribution to radiation dose from the above-named nearby sites of potential releases yielded a combined total of 0.067 mrem to such an individual (Poston et al. 2006). Routine PSF operations as a result of implementing the proposed action would result in a cumulative total annual dose of about 0.09 mrem.[17] It may be noted, however, that the dose associated with the PSF would likely be lower than that from current PNNL R&D operations in the 300 Area and may result in a small net decrease in cumulative impacts as presently experienced.

Table 5.9 shows a broader view of cumulative radiological impacts on human health and safety within the affected population, including the projected contribution from PSF.

Based on the dose estimates in Table 5.9, whether PNNL R&D activities are carried out in the PSF, the 300 Area facilities, or not at all, there would be no appreciable difference in cumulative impacts on human radiological health and safety.

Other types of impacts from operation of the PSF were found to be small and would generally be similar to those from current PNNL activities in the nearby 300 Area that are scheduled for relocation to the proposed facility. Therefore, operation of the PSF would result in minimal net change to cumulative impacts on the surrounding environment.

Impacts from constructing the proposed facility, such as additional traffic and construction emissions, would be temporary and similar to those associated with any other commercial building of comparable size. Construction is not expected to affect resources that are unique, in short supply, or otherwise sensitive; therefore, cumulative impacts on such resources would be negligible.

(17) For perspective, the average dose to an individual in the Richland area from naturally occurring sources is about 300 mrem/yr.

Table 5.9. Estimated Past, Present, and Reasonably Foreseeable Cumulative Population Dose and Health Effects in the Hanford Environs from Release of Radioactive Material to the Atmosphere[(a)]

Source of Impacts	Dose (person-rem)	Inferred Latent Cancer Fatalities[(b)]
Hanford Production Operations 1944–1988 (DOE 1995)	100,000	60
Hanford Post-production Operations 1989–2005[(c)]	9	0
Ongoing (2005) and Proposed Operations		
PSF R&D (30-yr projection, 2010–2040)[(d)]	5	0
Hanford Operations (35-yr projection, 2005–2040) (after Poston et al. 2006)[(e)]	9	0
Columbia Generating Station, US Ecology Commercial Low-Level Waste Disposal, and other Non-DOE Commercial Sources (30-yr projection: 2010–2040) (Poston et al. 2006)	40	0
Reasonably Foreseeable Operations[(f)]		
Plutonium Finishing Plant Stabilization (DOE 1996a)	100	0
K Basin Fuel Treatment and Storage (DOE 1996b)	100	0
TWRS Phased Implementation Alternative (DOE and Ecology 1996)	400	0
Cumulative Totals		
Hanford Production Operations (1944–1988)	100,000	60
Post-production, All Sources (1989–2040)	<700	0
Perspective		
30-yr Cumulative Background Dose	3,000,000	2,000

(a) Assumes constant population of about 380,000. All doses given to one significant figure.
(b) Based on 0.0006 inferred LCFs per person-rem. Values rounding to less than 0.5 are considered to be zero.
(c) Based on Hanford Site Environmental Reports for calendar years 1989 through 2005.
(d) Based on 300 Area contribution to population dose over the past 5 years, but projected to occur at the PSF. over a 30-year facility lifetime.
(e) Estimate based on 2001 to 2005 population dose (5 years with 300 Area releases and 30 years without).
(f) Based on earlier NEPA documents.

5.2 Environmental Impacts of the No-Action Alternative

In the No-Action Alternative, the PSF would not be constructed, and PNNL R&D activities ongoing in the 300 Area, as described in Section 3, would be discontinued after about 2010. The impacts from such action would be largely programmatic and socioeconomic rather than environmental, resulting in loss of employment and delay or disruption of affected DOE and other agency research programs. For the immediate future, the environmental impacts of this alternative would be similar to those from current PNNL operations in the 300 Area, which are described in Section 4 and Section 5.1 of this document. The impacts would cease if and when those activities were ultimately shut down.

Adverse Impacts

PNNL's support of the nation's strategic goals in science, national security, energy, and the environment for DOE, NNSA, DHS, NIH, DoD, NRC, and EPA would be substantially reduced.

This alternative could result in potential dismissal of about 480 PNNL scientific and support staff for lack of programmatic support and funding. Such a decrease in the DOE and contractor workforce consisting of about 14,000 members (2004 data) would amount to about 3%. Changes of less than 5% in an existing labor force have been determined to have little effect on an existing community (DHUD 1976); thus, the socioeconomic impact would be minimal.

Scientific apparatus that would have been moved to the PSF would need to be transferred to other laboratories, excessed for commercial recycling, or disposed of at commercial facilities or on the Hanford Site.

Impacts associated with PNNL R&D operations in the 300 Area would continue at essentially the present level until operations cease. These impacts would be minimal as extrapolated from the Hanford Site Environmental Report for Calendar Year 2005 (Poston et al. 2006).

Beneficial Impacts

The shrub-steppe and other habitat within the PNNL Site would be undisturbed over the short term, the historic canal segment would remain undisturbed in place, and emissions and noise from construction of the PSF would not occur. Emissions and traffic from operation of existing 300 Area facilities would cease after they are eventually vacated.

6.0 Environmental Permits and Regulatory Requirements

It is the policy of DOE to carry out its operations in compliance with all federal, state, and local laws and regulations; Presidential Executive Orders; DOE Orders; and procedures. Environmental regulatory authority over the DOE Office of Science and its laboratories is vested in both federal and state agencies.

Both federal and state laws apply to construction and operation of the proposed facility. The environmental regulatory framework includes requirements regarding planning for facilities to protect air and water quality, human health, and the environment. Based on the research capabilities that would be transferred to the proposed facility, it is anticipated that the following environmental permits would be required for construction and operation of the PSF on the PNNL Site.

- **Industrial Wastewater Pretreatment Permit**. The City of Richland Pretreatment Program sets forth uniform requirements for users of the Publicly Owned Treatment Works for the City of Richland and enables the city to comply with all applicable state and federal laws, including the *Clean Water Act* (33 USC 1251 et seq.) and the General Pretreatment Regulations (40 CFR Part 403). The regulatory driver is the City of Richland's Pretreatment Program, Exhibit A to Title 17.30, dated October 5, 2004 (City of Richland 2004b). The responsible agency is the City of Richland.

- **Stormwater/Underground Injection Control Program**. The regulatory driver is the Washington Administrative Code 173-218, *Underground Injection Control Program*. The responsible agency is the Washington Department of Ecology. The purpose of the Underground Injection Control Program is to:
  - maintain the highest possible standards to prevent the injection of fluids that may endanger groundwaters
  - require the use of all known, available, and reasonable methods to prevent and control the discharge of fluids and waste fluids into the waters of the state
  - protect public health and welfare by preserving and protecting the quality of the state's groundwaters.

- **Construction Stormwater General Permit**. In 1987, Congress changed the federal *Clean Water Act* by declaring the discharge of stormwater (traditionally considered a non-point source) from certain industries and municipalities to be a point source of pollution requiring National Pollutant Discharge Elimination System (NPDES) permits or water quality discharge permits. The State of Washington is delegated authority by EPA to implement the water quality permit. The regulatory drivers are Washington groundwater quality standards (WAC 173-200) and the *Clean Water Act* (33 USC 1251 et seq.). The responsible agency is the Washington Department of Ecology.

- **Radioactive Air Emissions Permit**. A Notice of Construction application would be required that provides details about the proposed radioactive materials inventory, emission control systems, and dose modeling for the facility. The primary regulatory drivers are WAC 246-247, *Radiation Protection—Air Emissions*; WAC 173-480, *Ambient Air Quality Standards and Emission Limits for*

Radionuclides; and 40 CFR 61, *National Emission Standards for Hazardous Air Pollutants,* Subparts A and H and Appendix B, Method 114. The responsible agency is the Washington Department of Health.

- **Non-Radiological Air Pollutant Notice of Construction Approval Order**. These regulations require the submission of a Notice of Construction application to the Benton Clean Air Authority and its review and approval before a new emission source may be constructed. The application must demonstrate that installed equipment uses the Best Available Control Technology for non-radioactive air emissions. The regulatory drivers are WAC 173-400, *General Regulations for Air Pollution Sources*; WAC 173-401, *Operating Permit Regulations*; and WAC 173-460, *Controls for New Sources of Toxic Air Pollutants*, and Benton Clean Air Authority Regulation 1 (Benton Clean Air Authority 2005). The responsible agency is the Benton Clean Air Authority.

- ***Resource Conservation and Recovery Act* (RCRA; 42 USC 6901 et seq.) Hazardous Waste Facility Permit**. The RCRA permit is required for the storage and limited treatment of hazardous and/or mixed waste. The regulatory drivers are WAC 173-303, *Dangerous Waste Regulations*, and 40 CFR Part 270, *EPA Administered Permit Programs: the Hazardous Waste Permit Program*. The responsible agency is the Washington State Department of Ecology.

- **Protection of Plant and Animal Species**. The *Endangered Species Act* (16 USC 1531 et seq.), *Bald and Golden Eagle Protection Act* (16 USC 668 et seq.), and *Migratory Bird Treaty Act* (16 USC 703-712) all identify requirements that must be met to protect native plant and animal species and the ecosystems upon which they depend. The *Endangered Species Act* is the law most applicable to the proposed action. If a federal action may affect a threatened or endangered species or designated critical habitat, the agency must consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service to ensure the action is not likely to jeopardize the continued existence of these species.

- **Cultural and Historic Resource Protection**. Federal agencies must preserve and protect cultural resources in a spirit of stewardship to the extent feasible given the agency's mission. DOE responsibilities are defined by a number of regulations and policies, including the *National Historic Preservation Act* (16 USC 470 et seq.), the *Archaeological Resources Protection Act of 1979* (16 USC 470aa et seq.), the *Native American Graves Protection and Repatriation Act* (25 USC 3001 et seq.), and the *DOE Native American Indian & Alaska Native Tribal Government Policy (DOE 1992, 2006c)*. The *National Historic Preservation Act* is the law most applicable to the proposed action; it requires that agencies consider the effect of their actions on properties included in or eligible for inclusion in the National Register of Historic Places.

7.0 Notice to Tribal and Government Agencies

Advance notice of DOE's intent to prepare this EA and briefings as requested were provided to the following agencies and Tribal governments. The draft EA was also provided to these agencies and Tribal governments for review and comment.

- Nez Perce Tribe
- Confederated Tribes of the Umatilla Indian Reservation
- Yakama Nation
- Confederated Tribes of the Colville Reservation
- Wanapum
- U.S. Environmental Protection Agency - Region 10
- U.S. Fish and Wildlife Service
- Federal and Washington State Congressional Representatives
- Washington State Department of Ecology
- Washington State Department of Health
- Washington State Department of Fish and Wildlife
- Washington State Historic Preservation Office
- Oregon Department of Energy
- Benton and Franklin Counties
- Port of Benton
- Cities of Richland, Pasco, Kennewick, and West Richland.

Availability of the draft EA for public review and comment was announced in local news media. During the public comment period, the draft EA was provided upon request to interested individuals. It was also made available in the DOE Public Reading Room (Consolidated Information Center at Washington State University-Tri-Cities) and through the DOE Pacific Northwest Site Office Website (http://pnso.oro.doe.gov/).

The EA was revised in response to comments received during the public review period, and the final EA was prepared. Comments received on the draft EA and the DOE responses are listed in Appendix D of this final EA. The final EA is available at the WSU-Tri-Cities DOE Public Reading Room and on the PNSO Website (http://pnso.oro.doe.gov/).

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8.0 References

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64 FR 61615. November 12, 1999. "Record of Decision: Hanford Comprehensive Land-Use Environmental Impact Statement." *Federal Register* (November 12, 1999). Online at http://www.gpoaccess.gov/fr/index.html

65 FR 24595. "Executive Order 13148 of April 21, 2000: Greening the Government through Leadership in Environmental Management." *Federal Register* (April 26, 2000). Online at http://www.gpoaccess.gov/fr/index.html

8.1.3 **United States Code (USC)** (Online at http://www.gpoaccess.gov/uscode/index.html)

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16 USC 1531 et seq. *Endangered Species Act of 1973*. Public Law 100-478, as amended.

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9.0 List of Preparers

David Biancosino
EA Document Manager
DOE Pacific Northwest Site Office

Nancy Carnes
Legal Counsel
DOE Oak Ridge Operations Office

Peter R. Siebach
NEPA Compliance Officer
DOE Chicago Office

Eric G. Damberg
EA Project Manager
Pacific Northwest National Laboratory

Daniel L. Edwards
PSL Project Manager for Environment, Safety, and Health
Pacific Northwest National Laboratory

Thomas Kiess
Reviewer
Department of Homeland Security

Iral C. Nelson
Lead Author: Section 5 – Environmental Consequences
Pacific Northwest National Laboratory

Kathleen Rhoads
PNNL Document Manager
Lead Author: Front Matter, and Sections 1 – Introduction and Background, 2 – Purpose and Need for Agency Action, and 3 – Description of Proposed Action and Alternatives
Pacific Northwest National Laboratory

Dillard B. Shipler
Peer Reviewer
Pacific Northwest National Laboratory

Lucinda Low Swartz
Peer Reviewer
Battelle Memorial Institute

Regan S. Weeks
Lead Author: Section 4 – Affected Environment, 6 – Environmental Permits and Regulatory Requirements, and 7 – Agencies and Tribal Governments Consulted
Pacific Northwest National Laboratory

Document Production Team

David R. Payson
Lead Editor
Pacific Northwest National Laboratory

Patricia Cleavenger
Hanford Technical Library Information Specialist
Pacific Northwest National Laboratory

Elaine Schneider
Graphics Design Specialist
Pacific Northwest National Laboratory

Susan Tackett
Document Design
Pacific Northwest National Laboratory

Laura Thierolf
Publications Assistant
Pacific Northwest National Laboratory