

Summary of the

Hanford Site Environmental Report

for Calendar Year 2001



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Copies of this summary booklet and the 2001 report have been provided to many public libraries in communities around the Hanford Site and to several university libraries in Washington and Oregon. Copies also can be found at DOE's Public Reading Room located in the Consolidated Information Center, Room 101L in Richland, Washington. Copies of the 2001 report can be obtained from Mr. R. W. (Bill) Hanf, K6-75, Pacific Northwest National Laboratory, P.O. Box 999, Richland, Washington 99352 (bill.hanf@pnl.gov) while supplies last. The reports can be accessed on the Internet at <http://hanford-site.pnl.gov/envreport> or www.hanford.gov/docs/annualrp01/index.htm.

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Rabbitbrush blooms across the Hanford Site in early fall.

Introduction

This booklet summarizes the *Hanford Site Environmental Report for Calendar Year 2001*. The report includes information and summary data that describe environmental management performance at the site, demonstrate the status of the site's compliance with applicable federal, state, and local environmental laws and regulations, and highlight significant environmental monitoring and surveillance programs and efforts. The document is written to meet requirements and guidelines of the U.S. Department of Energy (DOE) and the needs of the public.

This summary booklet is designed to briefly 1) describe the Hanford Site and its mission; 2) describe environmental programs at the Hanford Site; 3) discuss estimated radionuclide exposures to the public from 2001 Hanford Site activities; 4) summarize the status of compliance with the site's environmental regulations; and 5) present information on environmental monitoring and surveillance and groundwater protection and monitoring. Readers interested in more detailed information can consult the 2001 report or the technical documents cited and listed in that report.



The 300 Area is located just north of the city of Richland. This area covers 1.5 square kilometers (~0.6 square mile).

Overview

of the Hanford Site and its Mission

The Hanford Site lies within the semiarid Pasco Basin of the Columbia Plateau in southeastern Washington State. The site occupies an area of ~1,517 square kilometers (~586 square miles) located north of the city of Richland.

This large area has restricted public access and provides a buffer for the smaller areas on the site that historically were used for production of nuclear materials, waste storage, and waste disposal. The Columbia River flows eastward through the northern part of the Hanford Site and then turns south, forming part of the eastern site boundary.

The 78,900-hectare (195,000-acre) Hanford Reach National Monument was established by a Presidential Proclamation in June 2000 to protect the nation's only non-impounded stretch of the Columbia River above Bonneville Dam and the largest remnant of the shrub-steppe ecosystem once blanketing the Columbia River Basin. In 2001, DOE and the U.S. Fish and Wildlife Service were joint stewards of the monument with the U.S. Fish and Wildlife Service administering three major management units of the monument totaling ~66,775 hectares (~165,000 acres).

These included the:

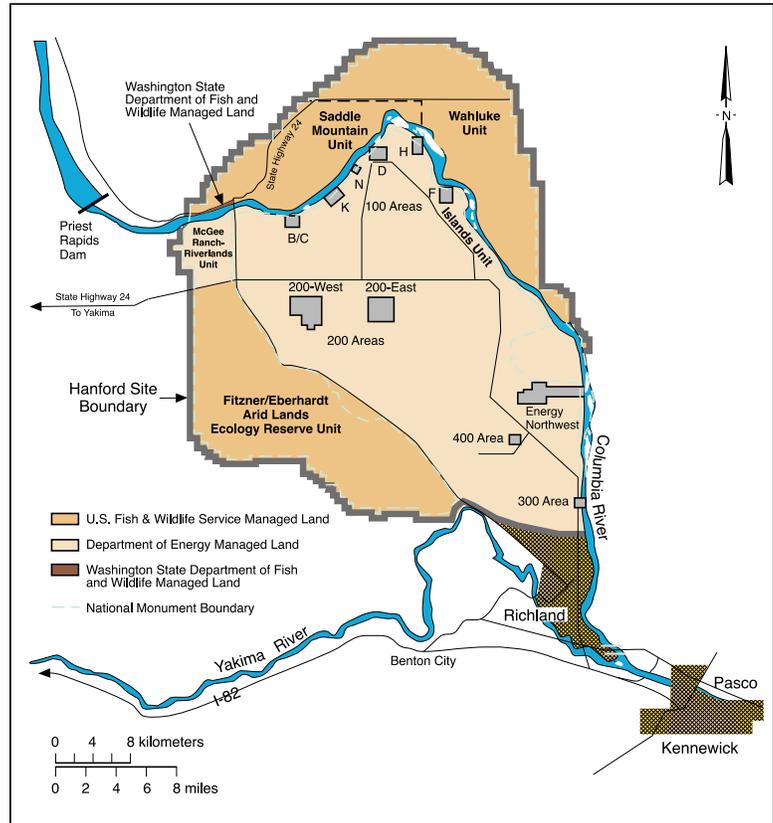
- Fitzner/Eberhardt Arid Lands Ecology Reserve Unit, a 312-square-kilometer (120-square-mile) tract of land in the southwestern portion of the Hanford Site
- Saddle Mountain Unit, a 130-square-kilometer (50-square-mile) tract of land located north-northwest of the Columbia River and generally south and east of State Highway 24
- Wahluke Unit, a 225 square-kilometer (87-square-mile) tract of land located north and east of both the Columbia River and the Saddle Mountain Unit.

The portion of the National Monument administered only by DOE included the:

- McGee/Riverlands area (north and west of State Highway 24 and south of the Columbia River)
- Columbia River islands in Benton County
- Columbia River corridor (one-quarter mile inland from the Hanford Reach shoreline) on the Hanford (Benton County) side of the river
- sand dunes area located along the Hanford side of the Columbia River north of Energy Northwest.

Approximately 162 hectares (~400 acres) along the north side of the Columbia River, west of the Vernita Bridge, and south of State Highway 243 is managed by the Washington State Department of Fish and Wildlife.

These lands have served as a safety and security buffer zone for site operations since 1943, resulting in an ecosystem that has been relatively untouched for nearly 60 years.



This map shows management units on the Hanford Reach National Monument.



Coyotes are often seen on the Wahluke Unit of the Hanford Reach National Monument. This unit is open to the public.

Site Description

The Hanford Site was acquired by the U.S. government in 1943, and until the 1980s, was dedicated primarily to the production of plutonium for national defense and the management of resulting waste.

The site is a relatively large, undisturbed area of shrub-steppe that contains a rich, natural diversity of plant and animal species adapted to the region's semiarid environment.

Terrestrial vegetation on the site consists of 10 major plant communities:

- sagebrush/bluebunch wheatgrass
- sagebrush/cheatgrass or sagebrush/Sandberg's bluegrass
- sagebrush-bitterbrush/cheatgrass
- greasewood/cheatgrass-saltgrass
- winterfat/Sandberg's bluegrass
- thyme buckwheat/Sandberg's bluegrass
- cheatgrass-tumble mustard
- willow or riparian
- spiny hopsage
- sand dunes.

Approximately 725 species of vascular plants have been identified on the site, and The Nature Conservancy of Washington has further delineated 30 distinct plant community types from within the 10 major communities.

There are two types of natural aquatic habitats on the Hanford Site. One is the Columbia River and associated wetlands, and the second is upland aquatic sites. The upland sites include small spring streams and seeps located mainly on the Fitzner/Eberhardt Arid Lands Ecology Reserve on Rattlesnake Mountain and West Lake, a small, natural pond near the 200 Areas.

More than 1,000 species of insects, 17 species of reptiles and amphibians, 44 species of fish, 258 species of birds, and 42 species of mammals have been found on the Hanford Site. Deer and elk are the major large mammals. A herd of Rocky Mountain elk has inhabited the



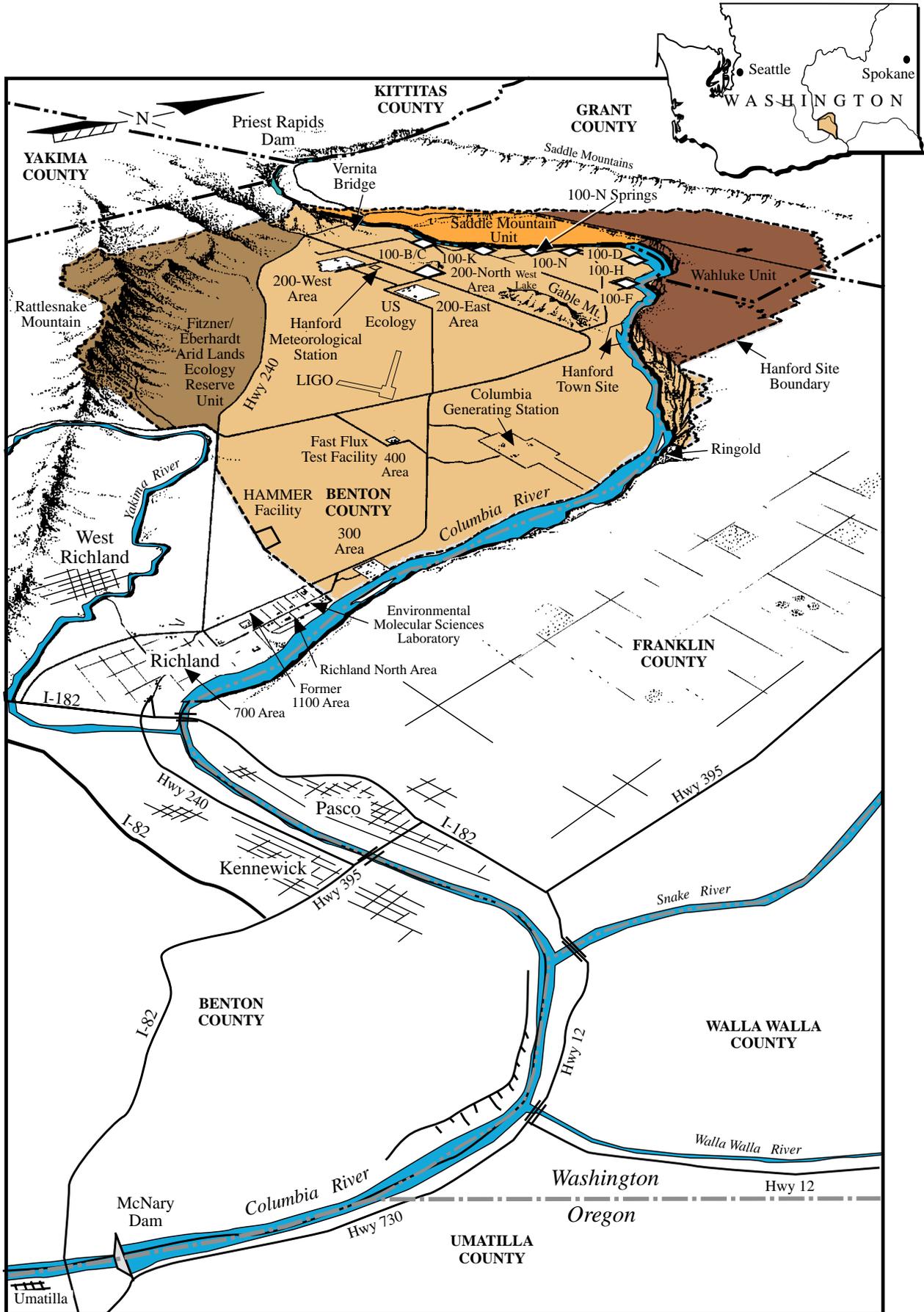
The red-tailed hawk is one of the most common hawks found on the Hanford Site.

site since 1972. Coyotes also are plentiful on the site. The Great Basin pocket mouse is the most abundant mammal.

Waterfowl are numerous on the Columbia River, and the bald eagle is a regular winter visitor. Salmon and steelhead are the fish species of most interest to sport fishermen and are commonly consumed by local Native American tribes. Fall chinook salmon spawn in the Hanford Reach, the most important natural spawning area in the mainstem Columbia.

Although no Hanford Site plant species have been identified from the federal list of threatened and endangered species, biodiversity inventory work conducted in collaboration with The Nature Conservancy of Washington identified 127 populations of 30 different rare plant taxa.

Several species of mammals, birds, mollusks, reptiles, and invertebrates occurring on the site are candidates for formal listing under the *Endangered Species Act*. The U.S. Fish and Wildlife Service lists the bald eagle as threatened. The bald eagle is a common winter resident and has initiated nesting on the site but has never successfully produced offspring.



This map shows the Hanford Site and surrounding area.



Underground waste storage tanks were built in groups (called tank farms) in the 200-East and 200-West Areas on the Hanford Site. The tank farms house 177 tanks (149 single-shell tanks and 28 double-shell tanks) that contain millions of liters of high-level liquid waste.



Nine nuclear reactors were constructed on the Hanford Site in the 100 Areas during the World War II Manhattan Project and the Cold War. This photo shows two 200-foot exhaust stacks being demolished at the 100-D/DR Area as part of site decontamination and decommissioning activities.

Operational Areas

The major DOE operational, administrative, and research areas on and around the Hanford Site include the following.

- The 100 Areas are located on the south shore of the Columbia River. These are the sites of nine retired plutonium production reactors (100-B, 100-C, 100-D, 100-DR, 100-E, 100-H, 100-KW, 100-KE, 100-N) that occupy ~11 square kilometers (~4 square miles).
- The 200-West and 200-East Areas are located on a plateau and are ~8 and 11 kilometers (~5 and 7 miles) south and west of the Columbia River. The 200 Areas cover 16 square kilometers (6.2 square miles). These areas house facilities that received and dissolved irradiated fuel and then separated out valuable plutonium.
- The 300 Area is located just north of Richland. This area covers ~1.5 square kilometers (~0.6 square mile). Most research and development at the site were carried out in the 300 Area.
- The 400 Area is located ~8 kilometers (~5 miles) northwest of the 300 Area. This area covers ~0.61 square kilometer (~0.23 square mile). It is the location of the Fast Flux Test Facility, scheduled for deactivation.
- The 600 Area includes all lands on the Hanford Site not occupied by the 100, 200, 300, and 400 Areas.
- The former 311-hectare (768-acre) 1100 Area is located between the 300 Area and the city of Richland. This area was transferred to the Port of Benton as part of DOE's Richland Operations Office economic diversification efforts and is no longer part of the site. DOE contractors continue to lease facilities in this area.
- The Richland North Area (off the site) includes the Environmental Molecular Sciences Laboratory and other DOE and contractor facilities, mostly leased office buildings, generally located in the northern part of the city of Richland.

Current Site Mission

For more than 40 years, Hanford Site facilities were dedicated primarily to the production of plutonium for national defense and management of the resulting waste. Hanford was the first plutonium production site in the world. In recent years, efforts at the site have focused on developing new waste treatment and disposal technologies and characterizing and cleaning up contamination left from historical operations.

Currently, the Hanford Site's primary mission includes cleaning up and shrinking the size of the site from ~1,517 square kilometers (~586 square miles) to ~194 square kilometers (~75 square miles) by the target date of 2012. *Accelerating Cleanup and Shrinking the Site* states that the cleanup mission includes three strategies:

- **restoring the Columbia River corridor** by continuing to clean up Hanford Site sources

of radiological and chemical contamination that threaten the air, groundwater, or Columbia River. It is expected that most river corridor projects will be completed by 2012.

- **transitioning the Central Plateau** (200-East and 200-West Areas) from primarily inactive waste storage to active waste characterization, treatment, storage, and disposal operations which are expected to last for another 40 years.
- **preparing for the future** by getting ready for long-term stewardship, other U.S. Department of Energy and non-DOE federal missions, and other public and private sector uses.

The goal of these strategies is to complete major portions of the site cleanup by 2012 and to do so in a manner that protects the environment and uses taxpayers' dollars wisely and efficiently.



Hanford At A Glance

Location	The U.S. Department of Energy's Hanford Site is located in southeastern Washington State near the city of Richland.
Dominant Feature	Rattlesnake Mountain on the Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve rises 1,074 meters (3,525 feet) above sea level.
Size	The site covers approximately 1,517 square kilometers (586 square miles).
Employees	DOE and its contractors employed ~10,000 workers in fiscal year 2001.
Mission	Hanford's mission is to safely clean up and manage the site's legacy wastes and shrink the site.
Budget	The annual budget is approximately \$1.6 billion.
Site Management	DOE Richland Operations Office and DOE Office of River Protection
Prime Contractors	Fluor Hanford, Inc. (nuclear legacy cleanup), Battelle Memorial Institute operates Pacific Northwest National Laboratory (research and development), Bechtel Hanford, Inc. (environmental restoration), Hanford Environmental Health Foundation (occupational and environmental health services), CH2M HILL Hanford Group, Inc. (storing and retrieving waste stored in 177 underground tanks), MACTEC-ERS (tank farm and waste site vadose zone characterization), and Bechtel National, Inc. (design, build, and commission a waste treatment plant to vitrify Hanford's tank waste).



This photo shows construction of the new Waste Treatment Plant currently being built on the Hanford Site. The plant is located on the Central Plateau outside of the 200-East Area.

Environmental Management

A major focus of DOE's environmental management mission at Hanford is cleanup of the site's waste from more than 45 years of nuclear weapons production. Managing this legacy waste—as well as other waste from past and current operations—involves safe storage, treatment, and final disposal of a large amount and variety of radioactive and chemical materials. It also involves remediating several hundred inactive waste disposal sites and stabilizing inactive facilities and the material inside them to prevent leaks or avoidable radiation exposures. Environmental restoration and pollution prevention are key parts of the environmental management mission.

An agreement between DOE, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency (EPA), known as the Tri-Party Agreement, provides the legal and procedural basis for cleanup of waste sites at Hanford. The Tri-Party Agreement contains a schedule, using numerous enforceable major and interim milestones and unenforceable target dates, which reflects a concerted goal of achieving full regulatory compliance and remediation.



The Hanford Site contains underground storage tanks that contain 204 million liters (54 million gallons) of hazardous and radioactive wastes—enough to fill nearly 2,800 railroad tanker cars.



This historical photo shows construction of radioactive waste storage tanks. There were 177 tanks built at the Hanford Site between 1943 and 1985. A major focus of DOE's mission is to clean up the legacy waste stored in these tanks.

Waste Storage, Treatment, and Disposal

Waste management at Hanford includes designing, building, and operating a variety of facilities to store, treat, and prepare the waste for disposal. At Hanford, a large part of this process involves safely managing 177 underground storage tanks (149 single-shell tanks and 28 double-shell tanks) that contain millions of liters of high-level liquid waste.

Cleanup activities on the Hanford Site generate radioactive, hazardous, and mixed waste. This waste is handled and prepared for safe storage on the site or shipped to offsite facilities for treatment and disposal. In 2001, cleanup activities generated 328,500 kilograms (724,300 pounds) of solid mixed waste and 1.7 million kilograms (3.7 million pounds) of radioactive waste on the Hanford Site. There were also 127,000 kilograms (280,000 pounds) of mixed waste and 4.7 million kilograms (10.4 million pounds) of radioactive waste received at Hanford from offsite sources.

In addition to newly generated waste, significant quantities of legacy waste remain from years of nuclear material production and waste management activities. Most legacy waste from past operations at the Hanford Site resides in waste sites that comply with the *Resource Conservation and Recovery Act (RCRA)* or is stored awaiting cleanup and ultimate safe storage or disposal. Examples include high-level radioactive waste stored in single- and double-shell tanks and transuranic waste stored in vaults and on storage pads.

Waste Tanks

Underground waste storage tanks were built in groups (called tank farms) in the 200-East and 200-West Areas. The farms contain underground pipes so waste can be pumped between tanks, between farms, and between the 200-East and 200-West Areas.



Hanford workers monitor waste storage tanks every day. Since the 1950s, waste leaks from 67 single-shell tanks have been detected, and some of this waste has reached the groundwater underlying the 200 Areas.

Sixty percent of the nation's nuclear waste is stored in tanks at the Hanford Site. The DOE's goal is to safely remove the liquid waste from the tanks, separate the radioactive elements from non-radioactive chemicals, and create a solid form of waste that can be disposed. The approach selected to solidify the waste is called vitrification, a process that turns the liquid into a rock-like glass.

Since the 1950s, waste leaks from 67 single-shell tanks have been detected, and some of this waste has reached the groundwater underlying the 200 Areas. To date, scientists estimate that 2.8 to 3.9 million liters (750,000 to 1 million gallons) of radioactive waste have leaked from single-shell tanks. All single-shell tanks have exceeded their design life by about 30 years.

In 1998, Congress established the DOE Office of River Protection to manage storage, retrieval, treatment, and disposal of the high-level liquid waste stored in the underground tanks and close the tank farm facilities at the Hanford Site.



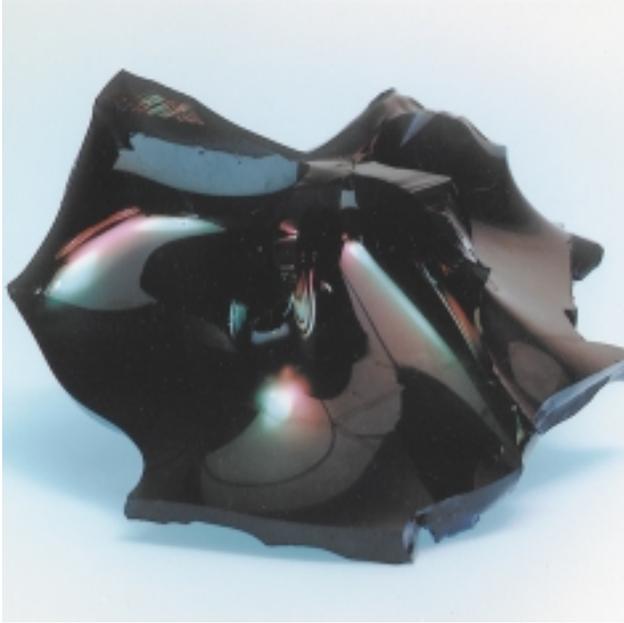
Sixty percent of the nation's nuclear waste is stored in tanks at the Hanford Site. The DOE's goal is to safely remove liquid waste from the tanks, separate the radioactive elements from non-radioactive chemicals, and create a solid form of waste that can be disposed.

The status of the waste tanks as of December 2001 is as follows:

- number of tanks assumed to have leaked
 - 67 single-shell tanks
 - 0 double-shell tanks
- chronology of single-shell tank leaks
 - 1956: first high-level waste tank reported as suspected of leaking (tank 241-U-104)
 - 1973: largest estimated leak reported (tank 241-T-106; 435,000 liters [115,000 gallons])
 - 1988: tanks 241-AX-102, -C-201, -C-202, -C-204, and -SX-104 confirmed as having leaked
 - 1992: latest tank (241-T-101) added to list of tanks assumed to have leaked, bringing total to 67 single-shell tanks
 - 1994: tank 241-T-111 was declared to have leaked again

To date, 129 of 149 (87%) single-shell tanks have been stabilized, and the tank stabilization program is ahead of schedule.

During 2001, four tanks were declared stable. Liquid waste from 13 single-shell tanks was pumped into the double-shell tank system, removing 1.9 million liters (500,000 gallons) of waste from the single-shell tanks.



Vitrification turns waste into glass that appears hard, shiny, and rock like. The glass traps radioactive and hazardous waste and keeps them from escaping into the environment.



DOE has chosen vitrification to stabilize and contain spilled and leaking radioactive and hazardous chemical waste. Vitrification uses electric power to melt soil and rock; the mass cools into glasslike blocks that will hold materials safely.

Immobilization of Waste Contained in Underground Tanks

Approximately 204 million liters (54 million gallons) of radioactive and hazardous waste are stored in 149 underground single-shell tanks and 28 underground double-shell tanks. This waste is an accumulation of more than 40 years of plutonium production operations. The DOE River Protection Project currently is upgrading tank farm facilities to deliver waste from underground storage tanks to a new waste treatment facility.

The Waste Treatment Plant will be built on 26 hectares (65 acres) located on the Central Plateau outside of the Hanford 200-East Area. Currently, three major facilities are planned: a pretreatment facility, a high-level waste vitrification facility, and a low-activity waste vitrification facility. Supporting facilities also will be constructed. The River Protection Project is currently upgrading tank farm

facilities to deliver waste to the planned Waste Treatment Plant.

During 2001, infrastructure construction for the Waste Treatment Plant was completed. This included installation of an electrical substation, potable water services, effluent piping systems, and roads. Additionally, excavation for the Waste Treatment Plant footprint was begun. Construction, as defined by the Tri-Party Agreement, began in 2002.

Treatment will separate the waste into a low-radioactivity fraction and a high radioactivity and transuranic fraction. Both fractions will be vitrified in a process that will destroy or extract organic constituents, neutralize or deactivate dangerous waste, and immobilize toxic metals.

The immobilized low-radioactivity portion will be disposed of in a facility on the Hanford Site. The immobilized high-radioactivity fraction will be stored onsite until a geologic repository is available offsite for permanent disposal.

Liquid Waste Management

Liquid waste is managed in treatment, storage, and disposal facilities to comply with RCRA and state regulations, as briefly described below.

242-A Evaporator

The 242-A Evaporator processes double-shell tank waste into a concentrate and a process condensate stream. In 2001, the evaporator treated 3.2 million liters (840,000 gallons) of tank waste and produced 3.1 million liters (820,000 gallons) of process condensate that were sent to the Liquid Effluent Retention Facility.

Liquid Effluent Retention Facility

This facility consists of three RCRA-compliant surface basins that temporarily store liquid waste, including condensate from the 242-A Evaporator. Approximately 32.7 million liters (8.6 million gallons) of liquid waste were stored in the facility's basins at the end of 2001.

Effluent Treatment Facility

Liquid effluents are treated in the Effluent Treatment Facility (200-East Area) to remove toxic metals, radionuclides, and ammonia and destroy organic compounds. The treated effluent is stored in verification tanks, sampled and analyzed, and discharged to the State-Approved Land Disposal Site. Approximately 95.0 million liters (25.1 million gallons) of aqueous waste were treated in 2001.

200 Areas Treated Effluent Disposal Facility

This facility collects and disposes of non-RCRA-permitted waste that has been treated using best available technology / all known and reasonable treatment. In 2001, ~484 million liters (~128 million gallons) of effluent were discharged to two 2-hectare (5-acre) disposal ponds located east of the 200-East Area.



The 242-A Evaporator concentrates dilute liquid tank waste by evaporation. In 2001, the Evaporator treated 3.2 million liters (840,000 gallons) of tank waste.



The three basins shown in this photo of the Liquid Effluent Retention Facility are lined with two, flexible, high-density polyethylene membranes.



The 200 Areas Treated Effluent Disposal Facility treats and stores radioactive waste.

Solid Waste Management

Treatment, storage, and disposal of solid waste takes place at a number of locations on the Hanford Site, such as those described in the following paragraphs. Solid waste may originate from work on the Hanford Site or from sources offsite that are authorized by DOE to ship waste to the site.

Central Waste Complex

Ongoing cleanup and research and development activities, as well as remediation activities, generate the waste received at the Central Waste Complex from onsite sources. The waste includes low-level, transuranic, and mixed waste as well as radioactively contaminated polychlorinated biphenyls.

Waste Receiving and Processing Facility

The Waste Receiving and Processing Facility analyzes, characterizes, and prepares drums and boxes of waste for disposal. Waste destined for the facility includes Hanford's legacy waste as well as newly generated waste from current site cleanup activities. The waste consists primarily of cloth, paper, rubber, metal, and plastic.

Navy Reactor Compartments

Eight disposal packages containing defueled U.S. Navy reactor compartments were received in the 200-East Area during 2001. Four were submarine reactor compartments, and four were cruiser reactor compartments. This brings the total number of reactor compartments received to 102. All Navy reactor compartments shipped to the Hanford Site for disposal have originated from decommissioned nuclear-powered submarines or cruisers.

The Washington State Department of Ecology regulates the disposal of reactor compartments as dangerous waste because lead is used as shielding. The reactor compartments also are managed as mixed waste because of their radioactivity.



The Central Waste Complex receives waste from Hanford Site cleanup activities and from other DOE and Defense Department facilities.



Cloth, paper, rubber, metal, and plastic are sent to the Waste Receiving and Processing Facility.



Defueled reactor components from nuclear-powered submarines and cruisers are barged to the Hanford Site and buried in a trench in the 200-East Area.

Environmental Restoration

Environmental restoration at Hanford involves characterizing and remediating contaminated soil and groundwater; stabilizing contaminated soil; remediating disposal sites; decontaminating, decommissioning, and demolishing former plutonium production process buildings, nuclear reactors, and separation plants; maintaining inactive waste sites; transitioning facilities into the surveillance and maintenance program; and mitigating effects to biological and cultural resources from site development and environmental cleanup and restoration activities.



As of early 2002, the Environmental Restoration Disposal Facility had received 3.1 million metric tons (3.4 million tons) of contaminated soil and other waste.

Environmental Restoration Disposal Facility

This disposal facility is located near the 200-West Area and began operations in July 1996. Constructed with double liners and a leachate collection system, the facility was designed to serve as the central disposal site for contaminated waste removed during cleanup operations conducted under the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* on the Hanford Site.

Cleanup materials may include soil, rubble, or other solid waste materials contaminated with hazardous, low-level radioactive, or mixed (combined hazardous chemical and radioactive) waste. As of early 2002, the facility had received 3.1 million metric tons (3.43 million tons) of contaminated soil and other waste.

Waste Site Remediation

Remediation continued through 2001 at several liquid waste disposal sites in the 100-B/C, 100-H, 100-F, and 100-N Areas. In 2001, over 540,000 million metric tons (over 594,000 tons) of contaminated soil were removed from the remediation sites. This soil has been transported to the Environmental Restoration Disposal Facility since the beginning of waste site remediation operations in 1996.

Facility Decommissioning Project

Decontamination and decommissioning activities continued in 2001 in the 100-D/DR, 100-H, and 100-F Areas. These activities are conducted to support the interim safe storage

Status of Waste Site Remediation	
Location of Waste Site	Amount of Contaminated Soils Removed, metric tons (tons)
100-B/C Area	110,000 (121,000) in 2001; 732,000 (807,000) since startup
100-H Area	136,000 (150,000) in 2001; 413,000 (455,000) since startup
100-F Area	321,000 (353,000) in 2001; 470,000 (517,000) since startup
100-N Area	112,000 (123,000) since startup

of the four reactor buildings (D, DR, F, and H) for up to 75 years. Interim safe storage minimizes potential risks to the environment, employees, and the public and reduces surveillance and maintenance costs. These activities are conducted as non-time-critical removal actions under CERCLA. Demolition of D Reactor also was initiated in 2001 and progressed through three areas (the lunchroom, the valve pit and shops, and the fan room and ventilation system tunnels). Demolition work at F Reactor Fuel Storage Basin continues.

Revegetation and Mitigation Planning

The wetland habitat by the 100-B/C Area created in early 2000 near the Columbia River was enhanced with the planting of an additional 1.6 hectares (4 acres) along the slopes of Borrow Pit 24. This planting effort will provide the borrow area with a much needed seed source to promote continual restoration of the pit.

In January 2001, 50 bitterbrush seedlings were planted as additional mitigation for shrubs lost during the initial stages of the 618-4 Burial Ground remediation.

A new electrical transmission line with tower pads was installed to provide electrical power to the planned vitrification plant near the 200-East Area. The areas surrounding the tower pads that were disturbed during pad installations were revegetated during February 2001.

Monitoring of survival and growth continued for ~90,000 sagebrush seedlings that were planted on about 90 hectares (222 acres) at nine locations on the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit during December 2000. This effort was the last phase of sagebrush transplanting as compensatory mitigation for the disturbance of sagebrush habitat resulting from development of the site and infrastructure for the planned waste vitrification facility. Monitoring of these plants will continue through fiscal year 2004.



About 90,000 sagebrush seedlings were planted on the Fitzner/Eberhardt Arid Lands Ecology Reserve as part of revegetation efforts on the Reserve.

Groundwater/Vadose Zone Integration Project

The Groundwater/Vadose Zone Integration Project brings together all activities that affect Hanford's subsurface. Restoring the condition of the groundwater under the Hanford Site is a major focus of the project. The goal of groundwater restoration is to prevent contaminants from entering the Columbia River, reduce the contamination in areas of high concentration, prevent the movement of contamination, and protect human health and the environment.

During 2001, the Integration Project team compiled an array of accomplishments that span its key focus areas – Site-Wide Fieldwork Integration Focus Area, the System Assessment Capability Focus Area, Science and Technology Focus Area, Integration of Information Focus Area, Technical Review Focus Area, and Public Involvement Focus Area. The efforts within these task areas directly support the DOE's plan for the Hanford Site.



Hanford activities follow the requirements of the Endangered Species Act. The site has eight plant species and five bird species on the federal or state list of threatened or endangered species.

Compliance

with Environmental Regulations

It is DOE's policy that all activities be carried out in compliance with applicable federal, state, and local environmental laws and regulations, DOE Orders, Secretary of Energy Notices, DOE Headquarters and site operations office directives, policies, and guidance. This includes those specific requirements, actions, plans, and schedules identified in the Hanford Federal Facility Agreement and Consent Order (also known as the Tri-Party Agreement) and other compliance or consent agreements.

Both the DOE Richland Operations Office and the DOE Office of River Protection recognize the importance of maintaining a program of self-assessment and regulatory reporting to assure that environmental compliance is achieved and maintained at the Hanford Site.

The table on the following page summarizes DOE's compliance with federal acts at the Hanford Site in 2001. Performance related to the Hanford Federal Facility Agreement and Consent Order is described in the following subsection.

Compliance with Federal Acts at the Hanford Site in 2001

Regulation	What it Covers	2001 Status
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Sites already contaminated by hazardous materials	Work on these sites followed CERCLA requirements and met the schedules established by the Tri-Party Agreement.
Emergency Planning and Community Right-to-Know Act	The public's right to information about hazardous chemicals in the community and establishes emergency planning procedures	The Hanford Site met the reporting requirements contained in this act.
Resource Conservation and Recovery Act (RCRA)	Hazardous waste being generated, transported, stored, treated, or disposed. The act primarily covers ongoing waste management at active facilities.	The Washington State Department of Ecology identified two violations during 2001. Both violations were associated with chemical storage. DOE has implemented corrective action for one and has appealed the other. Resolution efforts are ongoing.
Clean Air Act	Air quality, including emissions from facilities and diffuse and unmonitored sources	According to the Washington State Department of Health, air emissions from Hanford Site facilities were well below state and federal standards. However, Washington State Department of Health issued five notices of corrective action regarding stack emissions and corrective efforts are ongoing.
Clean Water Act	Discharges to U.S. waters	The Hanford Site had two National Pollutant Discharge Elimination System Permits and seven State Wastewater Discharge Permits in 2001.
Safe Drinking Water Act	Drinking water supplies operated by DOE	There were 10 public water systems monitored on the Hanford Site in 2001.
Toxic Substances Control Act	Primarily chemicals called polychlorinated biphenyls	In 2001, DOE formed a team to resolve issues related to polychlorinated biphenyl issues on a sitewide basis at Hanford. The team created a users guide in 2001 to assure consistent interpretation and implementation of this act.
Federal Insecticide, Fungicide, and Rodenticide Act	Storage and use of pesticides	At the Hanford Site, pesticides are applied by licensed commercial pesticide operators.
Endangered Species Act	Rare species of plants and animals	Hanford activities followed the requirements of this act. The Hanford Site has eight plant species, two fish species, and five bird species on the federal or state list of threatened or endangered species.
American Indian Religious Freedom Act, Antiquities Act, Archaeological and Historic Preservation Act, Archaeological Resources Protection Act, Historic Sites Buildings and Antiquities Act, National Historic Preservation Act, and Native American Graves Protection and Repatriation Act	Cultural resources	One hundred fifty cultural resources reviews were conducted on the Hanford Site.
National Environmental Policy Act	Environmental impact statements for federal projects	Environmental impact statements and environmental assessments were prepared or conducted as needed.
Migratory Bird Treaty Act	Migratory birds or their feathers, eggs, or nests	Hanford activities used the ecological review process as needed to minimize any adverse effects to migratory birds. Over 100 species of birds on Hanford are protected by this act.

Hanford Federal Facility Agreement and Consent Order

A key element in Hanford's compliance program is the Tri-Party Agreement. The Tri-Party Agreement is an agreement among the EPA, Washington State Department of Ecology, and DOE to achieve compliance with the remedial action provisions of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and with treatment, storage, and disposal unit regulation and corrective action provisions of the *Resource Conservation and Recovery Act* (RCRA).

The Tri-Party Agreement 1) defines the RCRA and the CERCLA cleanup commitments, 2) establishes responsibilities, 3) provides a basis for budgeting, and 4) reflects a concerted goal to achieve regulatory compliance and remediation with enforceable milestones in an aggressive manner.

The Tri-Party Agreement has continued to evolve as site cleanup progresses. Significant changes to the agreement have been negotiated to meet the changing conditions and cleanup needs on the Hanford Site.



Waste tank safety issues for high-priority watch list tanks were mitigated or resolved in accordance with Tri-Party Agreement milestone M40-00.

In 2001, 39 of 41 specific Tri-Party Agreement cleanup milestones were completed on or before their required due dates. One milestone was delayed because of unanticipated costs and contracting issues, and one is expected to be completed under an agreement between DOE and the Washington State Department of Ecology.

Environmental Occurrences

An environmental occurrence is any sudden or sustained deviation from a regulated or planned performance at a DOE operation that has environmental protection and compliance significance.

Environmental releases of radioactive and regulated materials from the Hanford Site are reported to DOE and other federal and state agencies as required by law. The specific agencies notified depend on the type, amount, and location of the individual occurrence. The Hanford Site Occurrence Notification Center maintains both a computer database and a hardcopy file of event descriptions and corrective actions.

During 2001, there were no environmentally significant emergency occurrence reports filed. There was one environmentally significant unusual occurrence report filed in 2001.

In May 2001, a subcontractor working at the 600-23 burial ground unearthed an unknown piece of equipment with a liquid reservoir. Approximately 38 liters (10 gallons) of an oily substance had leaked from this reservoir into the ground. Laboratory analysis revealed the presence of polychlorinated biphenyls in the spilled substance. The spill was entirely contained, and the equipment and contaminated soil were disposed of at the Environmental Restoration Disposal Facility.



Driving or riding in a car 1.0 kilometer (0.6 mile) carries the same risk as the 2001 radiation dose to a maximally exposed individual. This individual would receive the same dose by flying about 2.2 kilometers (1.4 miles) on a commercial airliner.

Potential

Radiological Doses from 2001 Hanford Operations

In 2001, scientists evaluated potential radiological doses to the public and biota resulting from exposure to Hanford Site liquid effluents and airborne emissions to determine compliance with pertinent regulations and limits.

The potential dose to the maximally exposed individual in 2001 from site operations was 0.009 millirem (9×10^{-5} millisievert) per year. Special exposure scenarios not included in this dose estimate include the hunting of game animals residing on the Hanford Site, and exposure to radiation at a publicly accessible location near the site boundary with the maximum exposure rate. Doses from these scenarios were small compared to the annual DOE dose limit.

The national average dose from background sources, according to the National Council on Radiation Protection, is ~300 millirems (3 millisieverts) per year; the current DOE radiological dose limit for a member of the public is 100 millirems (1 millisievert) per year. Therefore, the maximally exposed individual potentially received 0.009% of the DOE limit and 0.003% of the national average background dose.

Summary of Potential Radiological Doses from 2001 Hanford Operations

Radiological Dose Assessments	Dose Parameters	Dose
Average radiological dose from natural sources and consumer products	The dose limit includes sources such as cosmic, terrestrial, internal, and radon.	300 millirems per year
DOE's annual radiological dose limit for a member of the public	The dose limit includes air, drinking water, food, recreation and external radiation exposure pathways.	100 millirems per year
Maximally exposed individual	This hypothetical person's diet, dwelling place, and other factors were chosen to maximize the combined doses from all reasonable environmental pathways of exposure to radionuclides in Hanford Site effluents and emissions. In 2001, this individual was located at Sagemoor, directly across the Columbia River from the 300 Area.	0.009 millirem per year
Collective dose	The collective dose is based on a population residing within 80 kilometers (50 miles) of Hanford Site operating areas.	0.4 person-rem per year
Maximum Hanford Site boundary dose	Boundary dose rates are not used to calculate annual doses to the general public because no one can actually reside at the boundary locations. The highest boundary location exposure rate in 2001 was measured along the 100-N Area shoreline of the Columbia River.	0.015 millirem per hour
Dose to people consuming drinking water at the Fast Flux Test Facility	The potential dose to Fast Flux Test Facility workers assumes a consumption of 1 liter of drinking water from onsite wells per day (0.26 gallon per day) for 240 days.	~0.02 millirem per year
Maximum dose to non-DOE workers on the site (per <i>Clean Air Act</i> standards)	Doses to members of the public employed at non-DOE facilities that were outside access-controlled areas on the Hanford Site.	0.12 millirem per year
Individual dose from non-DOE sources	Various non-DOE industrial sources of public radiation exposure exist at or near the Hanford Site.	~0.05 millirem per year



Environmental Monitoring

Environmental monitoring at the Hanford Site consists of collecting and analyzing samples of air, surface water, groundwater, drinking water, soil, natural vegetation, agricultural products, fish, and wildlife. Air emissions and liquid discharges that may contain radioactive or hazardous materials also are monitored at and near site facilities.

Environmental monitoring at the Hanford Site includes near-facility environmental monitoring, surface environmental surveillance, groundwater monitoring, and vadose zone monitoring. Near-facility monitoring includes the analysis of environmental samples collected near major nuclear-related installations, waste storage and disposal units, and remediation sites. Surface environmental surveillance consists of sampling and analyzing various media on and around the site to detect potential contaminants and assess their significance to environmental and human health. Groundwater sampling is conducted to determine the distribution of radiological and chemical constituents in groundwater. Vadose monitoring is conducted to better understand and alleviate the spread of subsurface contamination.

The overall objectives of these monitoring and surveillance programs are to demonstrate compliance with applicable federal, state, and local regulations; confirm adherence to DOE environmental protection policies; and support environmental management decisions.

Facility Effluent Monitoring

Liquid and airborne effluents that may contain radioactive or hazardous constituents are continually monitored when released to the environment at the Hanford Site. Facility operators perform the monitoring mainly through analyzing samples collected at points of release into the environment. Effluent monitoring data are evaluated to determine the degree of regulatory compliance for each facility and/or the entire site. The evaluations are also useful to assess the effectiveness of effluent treatment and pollution-management practices.

In 2001, only facilities in the 200 Areas discharged radioactive liquid effluents to the ground, which went to the State-Approved Land Disposal Site. Radioactive air emissions usually come from a building stack or a vent. Radioactive emission discharge points are located in the 100, 200, 300, and 400 Areas. Non-radioactive air pollutants from such things as diesel-powered electrical generating plants were monitored. In 2001, the 200 Areas tank farms produced reportable ammonia emissions.

Radioactive Liquid Effluents

Liquid effluents are discharged from facilities in all areas of the Hanford Site. Effluents that normally or potentially contain radionuclides include cooling water, steam condensate, process condensate, and wastewater from laboratories and chemical sewers. These wastewater streams are sampled and analyzed for total alpha and total beta levels as well as for selected radionuclides.

In 2001, only facilities in the 200 Areas discharged radioactive liquid effluents to the ground, which went to a state-permitted disposal site at Hanford. Liquid waste containing both radioactive and hazardous contaminants are stored at the 200 Areas in underground waste storage tanks or monitored interim storage facilities.

Radioactive Airborne Emissions

Radioactive airborne emissions from the Hanford Site to the surrounding region are a potential source of human exposure. Most of the radionuclides in effluents at the site are nearing levels indistinguishable from the low concentrations in the environment that occur naturally or originated from atmospheric nuclear-weapons testing. The environmental cleanup mission is largely responsible for the downward trend in radioactive emissions at Hanford.

The continuous monitoring of radioactive emissions involves analyzing samples collected at points of discharge to the environment, usually from a stack or vent. Samples are analyzed for gross alpha and gross beta concentrations as well as for selected radionuclides.

In the 100 Areas, radioactive airborne emissions originated from four points: the evaporation at the water-filled 100-K East and 100-K West Fuel Storage Basins, which contain irradiated nuclear fuel, the Cold Vacuum Drying Facility, the 105-KW integrated water treatment filter backwash system, and a low-level radiological laboratory.

In the 200 Areas, primary sources of radionuclide emissions were the Plutonium-Uranium Extraction Plant, Plutonium Finishing Plant, T Plant, 222-S Laboratory, underground waste storage tanks, and waste evaporators.

In 2001, 49 radioactive emission discharge points were active in the 200 Areas. In the 300 Area, primary sources of airborne radionuclide emissions were the 324 Waste Technology Engineering Laboratory, 325 Applied Chemistry Laboratory, 327 Post-Irradiation Laboratory, and 340 Vault and Tanks.

During 2001, the 600 Area had two radioactive emission points on the site.



Air samples collected in 2001 from areas located at or directly adjacent to Hanford Site facilities had higher radionuclide concentrations than did those samples collected farther away.



Local teachers have managed and operated community-operated environmental monitoring stations at nine locations near the Hanford Site since 1990.

Near-Facility Monitoring

Near-facility environmental monitoring is defined as routine monitoring near facilities that have the potential to discharge, or have discharged, stored, or disposed of radioactive or hazardous contaminants. Monitoring locations are associated with nuclear facilities such as the Plutonium Finishing Plant, Canister Storage Building, and the 100-K Fuel Storage Basins; inactive nuclear facilities such as N Reactor and the Plutonium-Uranium Extraction Plant; and active and inactive waste storage or disposal facilities such as burial grounds, cribs, ditches, ponds, underground waste storage tanks, and trenches.

Air

In 2001, routine monitoring for radioactivity in air near Hanford Site facilities used a network of continuously operating samplers at 76 locations. Air samplers were located primarily

at or within ~500 meters (~1,500 feet) of sites and/or facilities having the potential for, or history of, environmental releases and were predominantly located in the prevailing down-wind direction.

Air samples collected in 2001 from areas located at or directly adjacent to Hanford Site facilities had higher radionuclide concentrations than did those samples collected farther away. In general, radionuclide concentrations in most air samples collected near facilities in 2001 were at or near background levels.

Soil and Vegetation

Near-facility soil and vegetation sampling is conducted to detect the potential migration and deposition of facility effluents and emissions. In 2001, 92 soil samples and 75 vegetation samples were collected for analysis. The samples were collected on or adjacent to waste disposal sites

and from locations downwind and near or within the boundaries of operating facilities and remedial action sites.

In soil samples, cobalt-60, strontium-90, cesium-137, plutonium-239/240, and uranium were detected consistently in 2001. The concentrations of these radionuclides were elevated near and within facility boundaries compared to background concentrations.

In vegetation samples, strontium-90, cobalt-60, cesium-137, plutonium-239/240, and uranium were detected consistently in 2001. Concentrations of these radionuclides were elevated near and within facility boundaries compared to concentrations measured offsite. The results demonstrate a high degree of variability.

100-N Spring Water

Groundwater springs and/or shoreline seepage wells at the 100-N Springs are sampled annually to verify that the reported radionuclide releases to the Columbia River are not under-reported. The amount of radionuclides entering the Columbia River at these springs is calculated based on analyses of monthly samples collected near the shoreline.

In 2001, the levels of strontium-90 detected in samples from riverbank springs were highest in N Springs wells Y302 and Y303. None of the concentrations exceeded the DOE derived concentration guide value. Tritium and gamma-emitting radionuclide concentrations were below analytical detection limits in 2001.



Perennial vegetation samples have been collected on and around the Hanford Site for more than 50 years. Vegetation samples consist of new growth leaf cuttings.

Investigative Sampling

Investigative sampling was conducted in operations areas to monitor the presence or movement of radioactive and/or hazardous materials around areas of known or suspected contamination or to verify radiological conditions at specific project sites.

Generally, the predominant radionuclides

discovered during these efforts were cesium-137, strontium-90, and plutonium-239/240 in the 100 and 200 Areas and uranium-234, -235, and -238 in the 300 Area.

Investigative samples collected in 2001 included mammals, animal feces, soils, and vegetation. In 2001, there were 20 instances of radiological contamination in investigative soil samples.

There were 31 instances of radiological contamination in investigative vegetation samples in 2001. Of the 31 instances, 27 were identified as tumbleweeds or tumbleweed fragments, one as grass, and three as rabbit-brush. None of these samples were analyzed for specific radionuclide activities.

In 2001, 10 wildlife samples were collected. The maximum radionuclide concentrations in investigative wildlife samples in 2001 were in mouse feces collected in the 200-West Area. Contaminants included strontium-89/90, cesium-137, europium-154, europium-155, plutonium-238, and plutonium-239/240. The numbers of animals found to be radioactively contaminated in 2001 were the lowest since 1994, and the range of radionuclide activities were within historical levels.

Surface Environmental Surveillance

The Surface Environmental Surveillance Project measures the concentration of radionuclides and chemicals in environmental media and assesses potential effects of these materials on the environment and the public. Samples of air, surface water, sediment, soil and natural vegetation, agricultural products, fish, and wildlife are collected routinely or periodically. Ambient external radiation also is measured.

Air

Atmospheric releases of radioactive material from the Hanford Site to the surrounding region are a potential source of human exposure. Radioactive constituents in air are monitored at a network of air sampling locations on and around the Hanford Site.

Airborne radionuclide samples were collected at 45 continuously operating samplers: 24 on the Hanford Site, 11 near the site perimeter, 8 in nearby communities, and 2 in distant communities. Nine stations were community-operated environmental surveillance stations managed and operated by local school teachers as part of an ongoing DOE-sponsored program to promote public awareness of Hanford Site environmental monitoring programs.

At all locations, particulates were filtered from the air and analyzed for radionuclides. Air was sampled and analyzed for selected airborne radionuclides at key locations. Several radionuclides released at the site also are found worldwide from two other sources: naturally occurring radionuclides and radioactive fallout from historical nuclear activities not associated with Hanford operations. The potential influence of emissions from site activities on local radionuclide concentrations was evaluated by comparing differences between concentrations measured at distant locations within the region and concentrations measured at the site perimeter.



Food products were collected routinely in 2001 at several locations surrounding the Hanford Site. Routine samples were collected from locations downwind and upwind of the site. Samples also were collected at locations distant from the site to provide information on reference radiation levels in foodstuffs.



Soil samples are collected on and off of the Hanford Site and analyzed for gamma-emitting radionuclides. Analytical results are compared to results from previous years. There has been no appreciable increase in radionuclide concentrations in onsite soil in the last several years.

In 2001, the annual average gross alpha air concentrations measured at Hanford were comparable to levels measured at distant community locations, indicating that onsite levels were predominantly a result of natural sources and worldwide radioactive fallout.

The average gross alpha concentrations for perimeter locations and nearby communities were higher than the onsite and distant averages. The site perimeter annual average gross beta air concentration was slightly higher than distant community concentrations; however, the difference was not statistically significant.

Annual average atmospheric tritium concentrations for 2001 at the Hanford Site were slightly higher than values reported for 1996 through 2000. More tritium was released from the 300 Area in 2001 than in 2000, accounting for the increase in averages from 2000 to 2001. The highest measured concentration was only 0.036% of the DOE derived concentration guide.

Surface Water, Sediment, Shoreline Springs, and Drinking Water

Samples of surface water and sediment on and near the Hanford Site were collected and analyzed to determine the potential impact to the public and the aquatic environment from Hanford-originated radiological and chemical contaminants. Samples of Hanford Site drinking water are collected, analyzed, and compared with established federal and state standards.



Scientists routinely sample Columbia River water to assess potential environmental effects from Hanford operations. All radiological contaminant concentrations measured in 2001 were less than DOE derived concentration guides and Washington State ambient surface-water quality criteria levels.

Columbia River Water

Radiological and chemical contaminants enter the Columbia River along the Hanford Reach through seepage of groundwater contaminated from past operations and permitted, direct-discharges of liquid effluents from Hanford facilities. Water samples were collected from the river and analyzed to determine compliance with water quality standards.

All radiological contaminant concentrations measured in Columbia River water in 2001 were less than DOE derived concentration guides and Washington State ambient surface-water quality criteria levels. The concentrations of tritium, iodine-129, and total uranium were significantly higher at the Richland Pumphouse than at Priest Rapids Dam, indicating a contribution along the Hanford Reach. All concentrations were similar to those observed in recent years.

Transect (multiple samples collected across the river) and near-shore sampling in 2001 revealed elevated tritium levels along the Benton County shoreline near the 100-N Area, Hanford town site, 300 Area, and Richland Pumphouse.

Total uranium concentrations were elevated along the Franklin County shoreline near the 300 Area and the Richland Pumphouse and likely resulted from groundwater seepage and water from irrigation return canals on the east shore of the river that contained naturally occurring uranium. Slightly elevated strontium-90 concentrations were detected in some water samples collected at near-shore locations at the 100-N Area.

Several metals and anions were detected in transect samples collected upstream and downstream of the site. Arsenic, antimony, cadmium, chromium, lead, nickel, thallium, and zinc were detected in most samples, with similar levels at most locations.

Nitrate, sulfate, and chloride concentrations were slightly elevated, compared to mid-river samples, along the Franklin County shoreline at the Richland Pumphouse transects and likely resulted from groundwater seepage associated with extensive irrigation north and east of the Columbia River. All metal and anion concentrations (including arsenic) in Columbia River water samples collected in 2001 were below regulatory limits and similar to those observed in the past.

Columbia River Sediment

In 2001, samples of Columbia River surface sediment were collected above McNary Dam (downstream of the site), from the Priest Rapids Dam pool (upstream of the site), and along the Hanford Reach (including some riverbank springs). In addition, sediment samples were collected above Ice Harbor Dam on the Snake River.

Radionuclides consistently detected in river sediment adjacent and downstream of the Hanford Site during 2001 included potassium-40, cesium-137, uranium-238, plutonium-238, and plutonium-239/240. The concentrations of all other radionuclides were below detection limits for most samples. Cesium-137 and plutonium isotopes exist in worldwide fallout, as well as in effluents from Hanford Site facilities. Uranium occurs naturally in the environment in



Samples of water and sediment from river bank springs entering the Columbia River are analyzed for radionuclides, metals, and anions. In 2001, all radiological contaminant concentrations measured were less than the DOE derived concentration guides.

addition to being present in Hanford Site effluents. Radionuclide concentrations reported in river sediment in 2001 were similar to those reported for previous years. No federal or state freshwater sediment criteria are available to assess the sediment quality of the Columbia River.

Riverbank Spring Water

Water samples were collected from 10 Columbia River shoreline spring areas along the Hanford Site in

2001. The below normal flows on the Columbia River in 2001 allowed samples of water from riverbank springs to be collected in the spring and fall. All samples collected during 2001 were analyzed for gamma-emitting radionuclides, gross alpha, gross beta, and tritium. Samples from selected springs were analyzed for strontium-90, technetium-99, iodine-129, and uranium-234, -235, and -238. All samples were analyzed for metals and anions, with volatile organic compounds analyzed at selected locations. All analyses were conducted on unfiltered samples, except for metals analyses, which were conducted for both filtered and unfiltered samples.

Hanford-origin contaminants continued to be detected in water from riverbank springs entering the Columbia River along the Hanford Site during 2001. The locations and extent of contaminated discharges were consistent with recent groundwater surveys. Tritium, strontium-90, technetium-99, iodine-129, uranium-234, -235, and -238, metals, and anions (chloride, fluoride, nitrate, and sulfate) were detected in spring water. Volatile organic compounds were near or below the detection limits for most samples.



Scientists sample and analyze sediment from the Columbia River for radiological and chemical contaminants. In 2001, samples of Columbia River surface sediment were collected above McNary Dam, from the Priest Rapids pool, and along the Hanford Reach.

All radiological contaminant concentrations measured in riverbank springs in 2001 were less than the DOE derived concentration guides. However, the spring near well 199-N-8T that has historically exceeded the DOE derived concentration guide for strontium-90 only had observed flow during one (1997) sampling attempt in the last 6 years; thus, an alternative spring was sampled in the 100-N Area.

Tritium concentrations in water samples collected in 2001 from riverbank springs at the Hanford town site exceeded the state ambient surface-water quality criteria level of 20,000 picocuries per liter. The maximum tritium concentration in riverbank spring water collected in 2001 at the 100-N Area was 17,000 picocuries per liter, which was 86% of the state ambient surface water criteria level. At the 300 Area, the maximum tritium level was 12,000 picocuries per liter, which was 60% of the criteria. The strontium-90 concentration in riverbank spring water was greater than the criteria level at the 100-H Area location.



Water samples were collected from 10 Columbia River shoreline spring areas along the Hanford Site in 2001. Hanford-origin contaminants continued to be detected in water from riverbank springs along the Hanford Reach.

Total uranium concentrations exceeded the EPA drinking water standard in the 300 Area. The gross alpha concentration exceeded the ambient surface-water quality criteria level in riverbank spring water at the 300 Area, which is consistent with the elevated uranium levels. All other radionuclide concentrations in 300 Area spring water were less than the state ambient surface-water quality criteria levels.

Gross beta concentrations in riverbank spring water at the 100-B Area, 100-H Area, Hanford town site, and 300 Area were elevated compared to other riverbank spring water locations. Several of the radionuclides show what appear to be increasing trends since 1995; however, radionuclide concentrations measured in the early 1990s were similar to the 2001 concentrations. Annual fluctuations in these values may reflect the influence of bank storage during the sampling period.

Most metal concentrations measured in water from riverbank springs located on the Hanford shoreline in 1999 through 2001 were

below Washington State ambient surface-water acute toxicity levels. However, concentrations of chromium in the 100-B, 100-D, 100-F, 100-H, 100-K, 100-N, and 300 Areas spring water were above the state ambient surface water chronic toxicity levels.

Arsenic concentrations in water from riverbank spring water were well below the applicable state ambient surface-water chronic toxicity levels, but concentrations in all samples exceeded the federal limit for the protection of human health for the consumption of drinking water. Nitrate concentrations at all locations were below the EPA drinking water standard.

Riverbank Spring Sediment

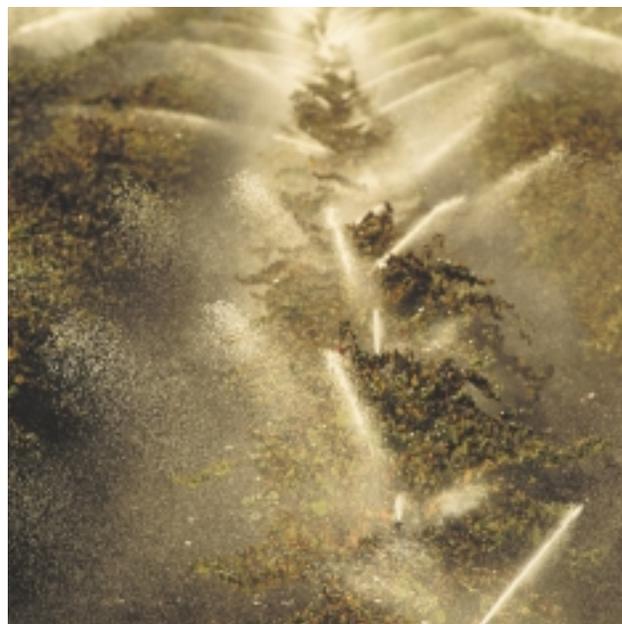
Sampling of sediment from riverbank springs began in 1993 at the Hanford town site and the 300 Area. Sampling of the riverbank springs in the 100-B, 100-F, and 100-K Areas began in 1995. Substrates at all other riverbank spring sampling locations consist of predominantly large cobble and are unsuitable for sample collection.

In 2001, sediment samples were collected at riverbank springs in the 100-B, 100-F, and 300 Areas. There was no sediment available for sampling at the 100-K and 100-N Area locations. In 2001, radionuclide concentrations in riverbank spring sediment were similar to those observed in river sediment.

Detectable amounts of most metals were found in all river sediment samples in 2001. Maximum and median concentrations of most metals were higher for sediment collected at Priest Rapids Dam.

The concentrations of cadmium, chromium, lead, nickel, thallium, and zinc had the largest differences between locations.

Metal concentrations in riverbank spring sediment samples in 2001 were similar to concentrations in Hanford Reach sediment samples.



In 2001, water samples were collected from an irrigation canal in Franklin County and an irrigation water supply on the Benton County shoreline.

Onsite Pond Water

Water was collected from two onsite ponds located near operational areas in 2001. Although the ponds are inaccessible to the public and, therefore, did not constitute a direct offsite environmental impact during 2001, they were accessible to migratory waterfowl and other animals, creating a potential biological pathway for the dispersion of contaminants.

With the exceptions of uranium-234 and uranium-238 in water samples from West Lake, radionuclide concentrations in onsite pond water were less than the DOE derived concentration guides. The median gross alpha and total uranium concentrations in West Lake exceeded ambient surface-water quality criteria. Concentrations of most radionuclides in water collected from onsite ponds in 2001 were similar to those observed in the past.

Irrigation Water

During 2001, water samples were collected from an irrigation canal located across the Columbia River and downstream from the



Samples of cabbage, beets, tomatoes and potatoes were obtained during the summer from gardens and farms located within selected sampling areas.



Locally produced red and white wines (2001 vintage grapes) were analyzed for gamma-emitting radionuclides and tritium. Concord grapes were collected during the fall harvest.

Hanford Site at Riverview and from an irrigation water supply on the Benton County shoreline near the southern boundary of the site. As a result of public concerns about the potential for Hanford-associated contaminants in offsite water, sampling was conducted to document the levels of radionuclides in water used by the public for irrigation.

Water in the Riverview irrigation canal also was sampled three times in 2001 during the irrigation season. Unfiltered samples of the canal water were analyzed for gross alpha, gross beta, gamma emitters, tritium, strontium-90, and uranium-234, -235, and -238. In 2001, radionuclide concentrations measured in this canal's water were at the same levels detected in Columbia River water. All radionuclide concentrations were below the DOE derived concentration guides and state ambient surface-water quality criteria levels. The strontium-90 levels in the irrigation water during 2001 were similar to those reported for the Columbia River at Priest Rapids Dam and the Richland Pumpouse.

The water sample from the Benton County irrigation pumping station was analyzed for the same analytes as the Riverview irrigation canal water, except for tritium. All radionuclide concentrations were below both DOE derived concentration guides and state ambient surface-water quality criteria levels and were similar to Columbia River concentrations.

Hanford Site Drinking Water

The quality of drinking water at the Hanford Site is monitored by routinely collecting and analyzing drinking water samples and comparing the resulting analytical data with established drinking water standards and guidelines.

In 2001, samples were collected from four locations on the site. All DOE-owned drinking water systems on the Hanford Site were in compliance with Washington State and EPA annual average radiological drinking water standards in 2001, and results were similar to those observed in recent years.

Food and Farm Products

Food products, including milk, vegetables, fruits, and wine, were collected routinely in 2001 at several locations surrounding the Hanford Site. Samples of alfalfa also were collected at selected locations. Routine samples were collected primarily from locations in the prevailing downwind directions where airborne effluents or fugitive dust from the Hanford Site could be deposited. Samples were collected also in generally upwind directions and at locations somewhat distant from the site to provide information on reference radiation levels in food.

Routine food and farm product sampling determines the potential influence of Hanford Site releases in two ways:

- through the comparison of results from downwind locations to those from generally upwind or distant locations
- through the comparison of results from locations irrigated with Columbia River water withdrawn downstream from the Hanford Site to results from locations irrigated with water from other sources.

Gamma scans (cobalt-60, cesium-137, and other radionuclides) and strontium-90 analyses were performed for nearly all products. Milk was analyzed for iodine-129 and tritium; wine also was analyzed for tritium.

Samples collected and analyzed in 2001 included milk, vegetables, fruit, wine, and alfalfa.

Strontium-90 was detected in one of three leafy vegetable samples collected for 2001. The result was similar to results seen in previous years. There were no gamma-emitting radionuclides detected in vegetable samples.

Strontium-90 and other man-made gamma-emitting radionuclides were not detected in grapes in 2001. Measurable levels of cesium-137 were reported slightly above the detection limit in samples from the Riverview area.

Iodine-129, strontium-90, and tritium were measured in milk samples. Levels of iodine-129



Milk samples were collected from seven dairies around the Hanford Site and analyzed for contaminants. Levels of iodine-129 in milk collected at downwind locations have remained relatively stable for the last 5 years.

in milk collected at downwind locations have remained relatively stable for the last 5 years and were slightly higher than levels measured upwind in Sunnyside. Strontium-90 was detected in 2 of 12 milk samples analyzed in 2001, and the results were close to the analytical detection limit. Tritium concentrations in milk samples were believed to be influenced by the source of water used by the dairies. Tritium levels were low in all samples but were higher in the Sagemoor area compared to milk from both the Wahluke and Sunnyside areas.

Tritium levels in all red and white wines were low, with concentrations in Yakima Valley wines lower when compared to concentrations in Columbia Basin wines.

Measurable levels of cesium-137 and other manmade gamma-emitting radionuclides were not detected in alfalfa in 2001. Strontium-90 was found above the detection limit in two of four samples, but levels were consistent with those seen in past years.

Fish and Wildlife

Contaminants in fish and wildlife that inhabit the Columbia River and Hanford Site are monitored for several reasons. Wildlife have access to areas of the site containing radioactive or chemical contamination, and fish can be exposed to contamination entering the river along the shoreline.

Fish and some wildlife species exposed to Hanford contaminants might be harvested for food and may potentially contribute to offsite public exposure. However, the amount of radiological contamination measured in fish and wildlife samples is well below levels known to cause adverse health effects.

In addition, detection of contaminants in wildlife may indicate that wildlife are entering contaminated areas (burrowing in waste burial grounds) or that materials are moving out of contaminated areas (through blowing dust or food-chain transport). Consequently, fish and wildlife samples are collected at selected locations annually.

Fish Samples

The amounts of radiological contamination measured in fish samples are well below levels that are known to cause adverse biological effects and contribute only a small proportion of the radiation dose to the maximally exposed individual. However, monitoring fish and other organisms for uptake and exposure to radionuclides at both nearby and distant locations continues to be important to track the extent and long-term trends of contamination in the Columbia River environment.

In 2001, five whitefish were collected from the Columbia River near the 100-N Area, and two whitefish were obtained from a reference site near Orofino, Idaho. Fillets and the eviscerated remains (carcass) of fish were analyzed for a variety of radiological contaminants, and results from the nearby and distant locations were compared.

In 2001, muscle samples were analyzed for cesium-137 and other gamma-emitting radionuclides. Cesium-137 results were below the analytical detection limit in all seven whitefish muscle samples collected in 2001. These results are consistent with results from samples analyzed and reported from 1995 through 2000 and support results reported throughout the 1990s that indicate a gradual decline in cesium-137 levels in whitefish.

Strontium-90 was only found in the two whitefish carcass samples analyzed in 2001 and both were from the reference site. Levels of strontium-90 in carcass tissues collected from the 100-N to 100-D Areas in 2001 were consistent with levels observed in samples collected over the preceding 5 years.

Strontium-90 concentrations in carcass tissue would need to exceed 600 picocuries per gram wet weight to be near the current DOE dose limit.

Goose Samples

Ten goose samples were collected from the Hanford Reach and one from the reference location near Vantage, Washington, in 2001. Radionuclide levels found in these samples were compared to levels in samples collected onsite in 1995, 1997, and 1999.

Cesium-137 was not detected in any goose muscle samples collected from the Hanford Site. The concentration in the sample obtained from the reference site in 2001 was reported to be 0.15 ± 0.02 picocuries per gram wet weight. The number of results reported at or below the analytical detection limit in 2001 was similar to the number reported for 28 goose samples collected from the Hanford Reach between 1995 and 2000. The 2001 levels were consistent with levels reported for other waterfowl collected on the Hanford Site and suggest that resident geese do not accumulate measurable amounts of cesium along the Hanford Reach of the Columbia River.



Ten goose samples were collected from the Hanford Reach and one was collected from the reference location near Vantage, Washington, in 2001.

Strontium-90 concentrations found in goose bones were similar between the two areas sampled on the Hanford Site in 2001 and the reference site. Median and maximum results reported from Hanford goose samples in 2001 were higher than any reported from 1995 through 2000, but were similar to results from reference samples obtained in 1995, 1999, and 2001.

While the apparent increase in strontium-90 concentrations in Hanford Site goose samples obtained in 2001 is noteworthy, the strontium-90 concentration in bone would need to exceed 60 picocuries per gram wet weight to be near the proposed DOE dose limit of 0.1 rad/day for terrestrial organisms.

Rabbit Samples

Rabbits are good indicators of regional radioactive contamination because they have relatively small home ranges, occupy burrows, and can enter fenced-restricted areas. However, because of the cyclic-patterns of the populations over time, sampling rabbits can be very difficult when numbers are low.



Rabbits are good indicators of regional radioactive contamination because they have small home ranges, occupy burrows, and can enter fenced, restricted areas.

In 2001, muscle and bone samples of cottontail rabbits were collected from near the 100-N Area. Reference samples of rabbits were collected near Boardman, Oregon, in 1990.

Cesium-137 concentrations in muscle samples from four rabbits collected were all below the analytical detection limit. These results are similar to those seen from a reference location sampled in 1990 and do not indicate elevated exposures from Hanford-derived sources.

Strontium-90 concentrations in the bones of four rabbits were all above the analytical detection limit. Three of the four sample results were reported near the analytical detection limit. Results from animals collected on the site suggest onsite exposure to low levels of strontium-90 around the 100-N and 200 Areas. Although low sample sizes are available to interpret the long-term trends, major changes in strontium-90 within rabbit bone tissues are not apparent over the past decade. Strontium-90 concentrations in bone tissues would need to exceed 60 picocuries per gram wet weight to be near the proposed DOE dose limit.

Soil and Vegetation Surveillance

Soil surveillance provides information on long-term contamination trends and baseline environmental radionuclide concentrations at undisturbed locations.

Surveillance of perennial vegetation provides information on atmospheric deposition of radioactive materials in uncultivated areas and at onsite locations adjacent to potential sources of manmade radioactivity.

Accordingly, radionuclide concentrations in soil and perennial vegetation provide a baseline against which unplanned releases can be compared.

Soil and perennial vegetation samples have been collected on and around the Hanford Site for more than 50 years. Consequently, a large database exists that thoroughly documents onsite and offsite levels of manmade radionuclides in soil and perennial vegetation at specific locations.

Routine radiological surveillance of soil and vegetation on and around Hanford was last conducted in 1998. In 2001, 13 vegetation samples and 38 soil samples were collected.

Soil Samples

In 2001, soil samples were collected onsite, at the Fitzner/Eberhardt Arid Lands Ecology Reserve, at the site perimeter, and at distant locations. All samples were analyzed for gamma-emitting radionuclides, strontium-90, uranium-234, -235, -238, and plutonium-238, -239/240. Selected samples were analyzed for americium-241. The 2001 results were compared to results from 1993, 1994, and 1998.

In 2001, observed mean radionuclide concentrations in onsite soil samples analyzed for plutonium isotopes, strontium-90, cesium-137, uranium-238, and americium-241 were at or below their respective averages from 1993, 1994, and 1998. This indicated that there has



In 2001, soil samples were collected onsite, at the Fitzner/Eberhardt Arid Lands Ecology Reserve on the northeastern side of Rattlesnake Mountain, at the site perimeter, and at distant locations.

been no appreciable increase in radionuclide concentrations in onsite soil in the last several years. There were no increases in soil concentrations of any measured radionuclide at distant or perimeter locations.

The onsite average soil concentrations in 2001 were higher than at the site perimeter or distant locations for the radionuclides measured. This was consistent with historical data and reflected the higher onsite soil concentrations associated with years of nuclear materials production.

Maximum soil concentrations of several radionuclides at various distance classes were higher in 2001 than in previous years. Maximum concentrations of strontium-90 and uranium-238 on the site were higher in 2001 than maximums observed since 1993.

At the site perimeter, the plutonium-239/240 maximum concentration was slightly higher than in recent years. Uranium-238 maximum concentrations at perimeter and distant locations were also higher in 2001 than in the last 8 years, but the differences were not statistically significant.

Vegetation Samples

Vegetation samples were collected at 13 locations on and around the Hanford Site in 2001. Samples were organized into four distinct groups: 1) onsite, 2) perimeter, 3) Columbia River shoreline, and 4) distant upwind.

Onsite vegetation sampling locations were generally selected in areas around industrial development of the site. Downwind perimeter locations were Ringold, Byers Landing, Sagemoor, and Riverview.

Perennial vegetation samples consisted of the current year's growth of leaves, stems, and new branches collected from sagebrush and rabbitbrush. Shoreline vegetation samples were usually taken from a predominant species at the sampling location.

Vegetation sampling results in 2001 generally confirmed observations from past sampling efforts. Strontium-90, cesium-137, plutonium-238, and uranium-238 concentrations were all below nominal detection limits at distant and shoreline locations, as were cesium-137 and strontium-90 concentrations at perimeter locations. Uranium-238 was detected in three of four perimeter samples collected.

Concentrations of plutonium-238 and uranium-238 in onsite samples were all less than the detection limit. Cesium-137 and strontium-90 were each measured in one sample, and results were similar to those from past years.

The percentage of samples collected in 2001 with measurable plutonium-239/240 concentrations increased relative to those samples collected in 1993, 1994, and 1998. Between 1993 and 1998, >40% of the vegetation samples analyzed had detectable concentrations of plutonium-239/240.

In 2001, plutonium-239/240 was detected in all vegetation samples collected and analyzed. The 2001 average concentrations for all distance classes increased relative to the average concentration measured during the last 8 years.



Vegetation samples were collected at 13 locations on and around the Hanford Site in 2001. Samples were organized into four distinct groups: 1) onsite, 2) perimeter, 3) Columbia River shoreline, and 4) distant upwind. Perennial vegetation samples consisted of the current year's growth of leaves, stems, and new branches collected from sagebrush and rabbitbrush.



Onsite vegetation sampling locations were generally selected in areas around industrial development of the site. Downwind perimeter locations were Ringold, Byers Landing, Sagemoor, and Riverview. These areas lie generally east and southeast of the site. They are expected to be in areas of highest offsite accumulation of contaminants from site stack emissions.

External Radiation and Radiological Surveys

External Radiation

External radiation also is surveyed on the Hanford Site. External radiation is defined as radiation originating from a source external to the body. External radiation consists of a natural component and a manmade component, which includes radionuclides generated for or from nuclear medicine, power, research, waste management, and consumer products containing nuclear materials (such as home smoke detectors).

Environmental radiation fields may be influenced by the presence of radionuclides deposited as worldwide fallout from atmospheric testing of nuclear weapons or those produced and released to the environment during the production or use of nuclear fuel. During any year, external radiation levels can vary from 15% to 25% at any location because of changes in soil moisture and snow cover.

In 2001, environmental external radiation exposure rates were measured by placing thermoluminescent dosimeters and pressurized ionization chambers at selected locations on and off the Hanford Site. External radiation and surface contamination surveys at specified locations were performed with portable radiation survey instruments.

Thermoluminescent dosimeters were positioned 1 meter (3.28 feet) above the ground at 29 locations on the site; 21 distant, community, and perimeter locations; and 26 locations along the Benton County shore of the Columbia River from Vernita to the mouth of the Yakima River. Ground contamination surveys were also conducted quarterly at 13 shoreline locations.

These measurements were made to estimate radiation exposure levels attributed to sources on the Hanford Site, estimate levels along the Hanford Reach shoreline, and help assess exposure to onsite personnel and offsite populations. Pressurized ionization chambers

were situated at four community-operated monitoring stations. Real-time exposure rate data were displayed at each station to provide information to the public and to serve as an educational tool for the teachers who manage the stations.

The highest dose rates measured in 2001 were along the shoreline near the 100-N Area. These higher rates measured along the 100-N Area shoreline have been attributed to past waste management practices in that area (i.e., disposal of liquid wastes to trenches located near the river shoreline).

In 2001, the maximum annual shoreline dose rate was 129 millirems, which was not significantly different from the maximum measured in 2000, but was significantly lower than the 5-year maximum of 173 millirems per year. However, exposure levels of this magnitude did not significantly add to dose rates for the public or Hanford workers.

Radiological Surveys

Radiological surveys were performed at selected Columbia River shoreline locations. The surveys showed that radiation levels were comparable to levels observed at the same locations in previous years. The highest dose rate was measured in winter along the 100-N shoreline.

Gamma radiation levels in air were monitored in 2001 at four community-operated air monitoring stations. These stations were located in Richland, north Franklin County, Basin City, and Toppenish.

Exposure rates measured at four offsite locations with pressurized ionization chambers were consistently between 7.4 and 8.9 microentgens per hour near Hanford and 7.9 and 8.7 microentgens per hour in Toppenish, a distant community location.

Groundwater Monitoring

In 2001, samples were collected from 735 monitoring wells to determine the distribution and movement of existing radiological and chemical constituents in Hanford Site groundwater and identify and characterize potential and emerging groundwater contamination problems. Samples were analyzed for ~40 different radiological constituents and ~290 different chemical constituents.

The total area of groundwater contaminant plumes with concentrations exceeding drinking water standards was estimated to be ~208 square kilometers (80 square miles) in 2001. This area, which is a decrease of ~1% compared to 2000, occupies ~14% of the total area of the Hanford Site. Most of the contaminant plume area, represented by tritium, lies southeast of the 200-East Area extending to the Columbia River.

The most widespread contaminants are tritium, iodine-129, technetium-99, uranium, strontium-90, carbon tetrachloride, nitrate, and trichloroethene. Plumes of carbon-14, cesium-137, cobalt-60, and plutonium occur in isolated areas in the 100 and 200 Areas.

Radioactive Contaminants

Tritium is one of the most widespread contaminants in groundwater across the Hanford Site and exceeded the 20,000-picocuries per liter drinking water standard in portions of the 100, 200, 400, and 600 Areas. Of these areas, tritium exceeded the 2-million-picocuries per liter DOE derived concentration guide in portions of the 200 and 600 Areas.

The highest tritium concentration measured at the Hanford Site in 2001 was 5.29 million picocuries per liter near the 618-11 burial ground, located near the Energy Northwest (the former Washington Public Power Supply System) site. Tritium levels on the site are expected to decrease because of dispersion and radioactive decay.



Groundwater monitoring personnel collect samples from across the Hanford Site. In 2001, samples were collected from 735 monitoring wells to determine the distribution and movement of existing radiological and chemical constituents in Hanford Site groundwater and identify and characterize potential and emerging groundwater contamination problems.



Scientists sample wells annually to monitor groundwater beneath the Hanford Site. In 2001, samples were analyzed for ~40 different radiological constituents and ~290 different chemical constituents. The most widespread contaminants are tritium, iodine-129, technetium-99, uranium, strontium-90, carbon tetrachloride, nitrate, and trichloroethene.



Pump-and-treat systems were constructed in the 100-D, 100-H, and 100-K Areas in the late 1990s. The systems are designed to remove contaminants from groundwater. Treated water is reinjected into the ground.

No groundwater samples showed iodine-129 concentrations above the 500-picocuries per liter DOE derived concentration guide in 2001. However, the iodine-129 plume at levels exceeding the drinking water standard (1 picocurie per liter) is extensive in the 200 and 600 Areas. At the Hanford Site, the highest level of iodine-129 detected in 2001 was 22.4 picocuries per liter near the T, TX, and TY tank farms in the 200-West Area.

Technetium-99, which has a half-life of 210,000 years, was found at concentrations greater than the 900-picocuries per liter drinking water standard in the 200-East and 200-West Areas. The highest level measured on the Hanford Site in 2001 was 81,500 picocuries per liter near the SX tank farm in the 200-West Area.

Total uranium has been detected at concentrations greater than the drinking water standard in portions of the 100, 200, and 300 Areas. The highest levels detected at the Hanford Site in 2001 were in the 200-West Area near U Plant,



In 2001, groundwater pump-and-treat systems processed thousands of kilograms (millions of liters) of contaminated groundwater. Contaminants removed included hexavalent chromium, strontium-90, carbon tetrachloride, nitrate, technetium-99, and uranium.

where uranium levels were 3,110 micrograms per liter and exceeded the DOE derived concentration guide.

In 2001, strontium-90 concentrations greater than the 8-picocuries per liter drinking water standard were found in one or more wells in the 100 and 200 Areas. Levels of strontium-90 exceeded the 1,000-picocuries per liter DOE derived concentration guide in the 100-K, 100-N, and 200-East Areas.

The 100-N Area had the widest distribution of strontium-90 detected at the Hanford Site during 2001. The maximum concentration detected was 12,000 picocuries per liter in the 200-East Area.

Carbon-14 concentrations occur in the 100-K Area and exceed the 2,000-picocuries per liter drinking water standard in two small plumes near the K-East and K-West Reactors. The maximum concentration in 2001 was 12,900 picocuries per liter near a former K-East Reactor waste disposal crib.

Cesium-137, which has a half-life of 30 years, was detected in three wells located near the inactive 216-B-5 injection well in the 200-East Area. The maximum cesium-137 concentration in 2001 was 1,910 picocuries per liter, which is greater than the interim drinking water standard. Cesium-137 appears to be restricted to the immediate vicinity of the former injection well.

Cobalt-60 was detected in the northwestern part of the 200-East Area. The maximum concentration measured in 2001 was 77.1 picocuries per liter at the BY cribs. This concentration was below the 100-picocuries per liter drinking water standard and the 5,000-picocuries per liter DOE derived concentration guide.

Plutonium was released to the soil column in the past at several locations in both the 200-West and 200-East Areas. The half-lives of plutonium-239 and plutonium-240 are 24,000 and 6,500 years, respectively. The only location where plutonium isotopes were detected in groundwater on the Hanford Site was near the inactive 216-B-5 injection well in the 200-East Area. Plutonium levels near the injection well have changed significantly since monitoring for plutonium began in the 1980s.

The maximum plutonium-239/240 concentration near this injection well during 2001 was 63 picocuries per liter, which exceeds the 30-picocuries per liter DOE derived concentration guide.

Summary of Pump-and-Treat Systems and a Soil-Vapor Extraction System

Location	Startup Date	Contaminant	Mass Removed (Groundwater Processed) in 2001	Mass Removed (Groundwater Processed) Since Startup
Groundwater Pump-and-Treat Systems				
100-D Area	1997	Hexavalent chromium	20.5 kilograms (96.7 million liters)	101.9 kilograms (550 million liters)
100-H Area	1997	Hexavalent chromium	5.8 kilograms (125.9 million liters)	27.5 kilograms (631.3 million liters)
100-K Area	1997	Hexavalent chromium	36.2 kilograms (338.8 million liters)	148.3 kilograms (1.24 billion liters)
100-N Area	1995	Strontium-90	0.18 curies (114.7 million liters)	1.1 curies (666.5 million liters)
200-West Area (200-ZP-1) Operable Unit	1994	Carbon tetrachloride	1,177 kilograms (326 million liters)	6,084 kilograms (1.67 billion liters)
200-West Area (200-UP-1) Operable Unit	1994	Carbon tetrachloride	2.41 kilograms (98.2 million liters)	20.6 kilograms (554.5 million liters)
	1994	Nitrate	3,540 kilograms (98.2 million liters)	20,487 kilograms (554.5 million liters)
	1994	Technetium-99	8.3 grams (98.2 million liters)	78.56 grams (554.5 million liters)
	1994	Uranium	15.5 kilograms (98.2 million liters)	136.7 kilograms (554.5 million liters)
Soil-Vapor Extraction				
200-West Area	1992	Carbon tetrachloride	710 kilograms	77,170 kilograms

Chemical Contaminants

Several non-radioactive chemicals regulated by EPA and Washington State also were present in Hanford Site groundwater. These were carbon tetrachloride, chloroform, chromium, cyanide, fluoride, nitrate, tetrachloroethene, cis-1,2-dichloroethene, and trichloroethene.

Of these chemicals, nitrate, chromium, and carbon tetrachloride were the most widely distributed in Hanford Site groundwater.

Nitrate is the most widespread chemical contaminant in Hanford Site groundwater because of its mobility in groundwater and the large volumes of waste containing nitrate discharged to the ground. However, the areas affected by levels greater than the drinking water standard are small.

In 2001, nitrate was measured at concentrations greater than the drinking water standard (45 milligrams per liter) in portions of the 100, 200, 300, 600, and former 1100 Areas. The maximum nitrate concentration measured on the Hanford Site in 2001 was 1,300 milligrams per liter in the 200-West Area.

Chromium was detected above the drinking water standard in 2001 at the 100-D, 100-H, 100-K, 100-N, 200-East, and 200-West Areas. The maximum detected concentration was 5,660 micrograms per liter in the 100-D Area.

In the hexavalent form, chromium is very mobile in groundwater. Groundwater pump-and-treat systems continued to operate in 2001 to reduce the amount of hexavalent chromium entering the Columbia River at the 100-D, 100-



The presence of chromium in groundwater beneath the 100-H Area is a concern because the adjacent riverbed is used by salmon for spawning. A pump-and-treat system currently is operating to reduce the rate at which chromium enters the Columbia River.

H, and 100-K Areas. The purpose of the pump-and-treat systems is to prevent discharge of hexavalent chromium into the Columbia River at concentrations exceeding 11 micrograms per liter, which is EPA's standard for protection of freshwater aquatic life.

Carbon tetrachloride contamination occurs above the 5-milligrams per liter drinking water standard in much of the

200-West Area and represents one of the most significant contaminant plumes at the Hanford Site. The plume, which covers an area of more than 11 square kilometers (4 square miles), extends past the 200-West Area boundary into the 600 Area.

Carbon tetrachloride has been found to have a high degree of mobility in groundwater. The highest concentration measured in 2001 was 7,400 micrograms per liter near the Plutonium Finishing Plant in the 200-West Area.

The highest chloroform concentrations were measured in the vicinity of the Plutonium Finishing Plant in the 200-West Area, where the maximum level was 160 micrograms per liter in early 2001. These concentrations are above the 100-micrograms per liter drinking water standard.

In 2001, trichloroethene was detected at levels greater than the 5-micrograms per liter drinking water standard in several wells in the 100, 200, and 600 Areas.

The most widespread area of contamination occurred in the 200-West Area. The highest concentration measured in 2001 was 21 micrograms per liter in a well northeast of the Plutonium Finishing Plant.

The highest levels of cyanide were detected in samples collected from wells in the north-western part of the 200-East Area. The maximum concentration measured in 2001 was 423 micrograms per liter, which is above the 200 micrograms per liter drinking water standard.

At this time, fluoride has a primary drinking water standard of 4 micrograms per liter and a secondary standard of 2 micrograms per

liter. Secondary standards are based primarily on aesthetic, rather than health, considerations. Fluoride was detected above the primary drinking water standard in two monitoring wells at the T tank farm in the 200-West Area in 2001. The maximum fluoride concentration was 4.9 micrograms per liter on the east side of T tank farm. A few other wells near T tank farm showed concentrations above the secondary standard.

Vadose Zone Monitoring and Characterization

The vadose zone is defined as the area between the ground surface and the water table. This subsurface zone also is referred to as the unsaturated zone or the zone of aeration. The vadose zone functions as a transport pathway or storage area for water and other materials located between the soil surface and the groundwater aquifers.

Historically, the vadose zone at industrialized and waste disposal areas at the Hanford Site has been contaminated with large amounts of radioactive and non-radioactive materials through the intentional and unintentional discharge of liquid waste to the soil column, the burial of contaminated solid waste, and the airborne contaminants deposited on the ground.

Depending on such factors as the makeup of the soil, the geology of the area, the nature of the waste, and the amount of water or other fluids available to mobilize the contaminant, contaminants can move downward and laterally through the soil column, can be chemically bound to soil particles (and immobilized), or can be contained by geologic formations.

Radioactive and hazardous waste in the soil column from past intentional liquid waste disposal, unplanned leaks, solid waste burial grounds, and underground tanks at the Hanford Site are potential sources of continuing and future vadose zone and groundwater contamination. Subsurface source characterization, va-



This photo shows a cone penetrometer being lowered into place at the Hanford Site to push sensors and probes into the soil to gather information about the vadose zone.

dose zone monitoring, soil-vapor monitoring, and vadose zone remediation were conducted in fiscal year 2001 to better understand the distribution and mechanisms that control the movement of subsurface contamination.

Vadose Zone Characterization

Vadose zone characterization activities at single-shell tank farms in fiscal year 2001 were concentrated at the B, BX, and BY tank farms in the 200-East Area and the S and SX tank farms in the 200-West Area.

Two new boreholes were drilled at Waste Management Area B-BX-BY through subsurface contaminant plumes.

A third borehole was drilled immediately outside the tank farms to obtain uncontaminated core for comparison with the contaminated material obtained in the tank farms.

Interim measures were completed at the single-shell tank farms in 2001 to minimize the subsurface movement of contaminants by preventing surface water from encroaching onto the tank farms.

Although these efforts are not strictly characterization efforts, they are important and related because they help minimize the spread of contamination beyond existing contaminated regions. During 2001, baseline spectral gamma logging of selected wells at past-practice, liquid waste disposal facilities began. The results will be a baseline against which future monitoring results can be compared.

Vadose zone characterization activities were completed in the 100-H Area to support remediation in the reactor areas. Finally, characterization activities were completed at two burial grounds in the 600 Area, north of the city of Richland. The results of these activities provide a clearer picture of the distribution of subsurface contaminants in this area.



Scientists collected data during a soil gas survey performed during summer 2001. The survey helped determine the direction and extent of tritium groundwater contamination downgradient of the 618-11 burial ground. Results from this survey were used to define the locations for groundwater sampling and monitoring well installation.

Vadose Zone Monitoring

Vadose zone monitoring occurred at four major areas on the Hanford Site in 2001.

Leachate and soil gas monitoring continued at the Environmental Restoration Disposal Facility and the Solid Waste Landfill. Also, soil gas monitoring at the carbon tetrachloride expedited-response-action site continued during fiscal year 2001.

Soil gas is monitored quarterly to determine concentrations of carbon dioxide, methane, oxygen, and several key volatile compounds. No contaminants of concern were discovered above reporting limits during the 2000/2001 sampling period.

During the year, borehole geophysical monitoring of dry wells in single-shell tank farms to detect leaks and the migration of subsurface contaminants continued.

In addition to these monitoring activities, several vadose zone monitoring instruments were installed at one borehole at Waste Management Area B-BX-BY tank farms on the Hanford Site. These instruments will provide continuous soil column monitoring in that tank farm.

Soil-vapor extraction is being used to remove carbon tetrachloride from the vadose zone in the 200-West Area. Three soil-vapor extraction systems are in use. As of September 2001, 77,169 kilograms (170,128 pounds) of carbon tetrachloride had been removed from the vadose zone since extraction operations started in 1991.

Technical Studies in the Vadose Zone

Technical studies in the vadose zone were designed to help develop new, innovative methods for cleanup and monitoring at the Hanford Site.

These studies include the demonstration and testing of several geophysical methods to monitor and characterize the soil column and use of chemical parameters to distinguish various sources of subsurface waste and subsurface moisture to understand transport processes in the vadose zone. A computer model is being developed to predict the migration of subsurface contaminants based on measured infiltration rates.

Infiltration experiments also are being conducted at a clastic dike site to determine the hydrologic properties of clastic dikes.

A 3-year study of clastic dikes and their influence on vertical movement of moisture and contaminants in the vadose zone began in fiscal year 2000 and continued in 2001.

The goal is to describe the geometric and hydrologic properties of clastic dikes and extrapolate those properties to the vadose zone beneath waste storage and disposal facilities.

Clastic dikes are common sedimentary structures in the vadose zone at the Hanford Site. The dikes are vertical to subvertical structures that are often contorted and irregular. They crosscut the normal subhorizontal sand and silt beds of the Hanford formation.

Previous investigators have proposed that the dikes may provide a preferential path for contaminated water leaking from waste tanks to move through the thick unsaturated zone to the unconfined aquifer. However, there is insufficient evidence to determine if that speculation is accurate. One goal of this study is to provide information that can be used to evaluate that speculation.



This is a photograph of the clastic dike exposed in the Army Loop Road excavation on the Hanford Site. Each grid shown in the front of the lowest exposed face is 2 meters (6.5 feet) wide by 1 meter (3.28) feet high. The blue tent in the background covers an infiltration test site.



Scientists used a geophysical technique known as spectral gamma logging to determine whether contaminants are moving through the soil. A small-diameter spectral gamma logging tool has been demonstrated in the 100 Areas of the Hanford Site.

Quality Assurance

Quality assurance and quality control practices are incorporated into all aspects of the Hanford Site environmental monitoring and surveillance programs.

Comprehensive quality assurance programs are conducted to assure data quality. The programs are implemented through quality assurance plans designed to meet requirements of the American National Standards Institute / American Society of Mechanical Engineers and DOE Orders. Quality assurance plans are maintained for all activities, and auditors verify conformance.

Quality control methods include, but are not limited to, replicate sampling and analysis, analysis of field blanks and blind reference standards, participation in interlaboratory cross-check studies, and splitting samples with other laboratories. Sample collections and laboratory analyses are conducted using documented and approved procedures.

When sample results are received, they are screened for anomalous values by comparing them to recent results and historical data. Analytical laboratory performance on the submitted double-blind samples, the EPA Laboratory Intercomparison Studies Program, and the national DOE Quality Assessment Program indicated that laboratory performance in 2001 was adequate overall, was excellent in some areas, and needed improvement in others.

Quality assurance/quality control for environmental monitoring and surveillance programs include procedures and protocols to:

- document instrument calibrations
- conduct program-specific activities in the field
- maintain groundwater wells to assure representative samples are collected
- avoid cross-contamination by using dedicated well sampling pumps.



Environmental samples are analyzed by trained staff according to approved and documented procedures.



Comprehensive quality assurance programs are maintained to assure the quality of data collected.



Swainson's hawks are one bird species monitored on the Hanford Site. They are summer residents of the site. Swainson's hawks are a state-monitored species in Washington State.

Environmental

Research and Monitoring

At the Hanford Site, a variety of environmental and cultural resource activities are performed to comply with laws and regulations, enhance environmental quality, and monitor the impact of environmental pollutants from site operations. Meteorological response is provided around the clock on the site in the event of a suspected or actual release of radioactive or hazardous material to the atmosphere. Comprehensive climatological data records are maintained to use in environmental impact assessment and dose reconstruction.

Scientists monitor the entire Hanford ecosystem and specific plant and animal species and habitats to assess the status of threatened, endangered, or commercially/recreationally important species and habitats and to identify impacts of Hanford Site operations on flora and fauna. Cultural resources on the site also are identified and evaluated to determine impacts from site operations. Historic buildings and structures are evaluated for their historic significance. This section summarizes activities conducted in 2001 to monitor the site's climatology and meteorology, assess the status of ecological monitoring and compliance, and monitor and manage cultural and historic resources.



Lightning strikes on the Hanford Site are monitored at the Hanford Meteorological Station. It is located on the 200 Areas plateau.



There were eight dust storms recorded at the Hanford Meteorology Station during 2001. There have been an average of five dust storms per year from 1945 to 2001.

Climate and Meteorology

Meteorological measurements are taken to support Hanford Site emergency preparedness and response, site operations, and atmospheric dispersion calculations for dose assessments. Hanford Site meteorologists provide weather forecasting and maintenance and distribution of climatological data.

Forecasting is provided to help manage weather-dependent operations. Climatological data are provided to help assess the environmental effects of site operations.

Local data to support the Hanford Meteorology Station operations are provided via the Hanford Meteorological Monitoring Network. This network consists of 30 remote monitoring stations that transmit data to the Hanford Meteorology Station via radio telemetry every 15 minutes.

The Hanford Meteorology Station is located on the 200 Areas plateau where the prevailing

wind direction is from the northwest during all months. The secondary wind direction is from the southwest. The average wind speed for 2001 was 3.4 meters per second (7.6 miles per hour). The peak gust for the year was 31 meters per second (69 miles per hour) on December 16.

There were eight dust storms recorded at the Hanford Meteorology Station during 2001. There have been an average of five dust storms per year at the station from 1945-2001.

Calendar year 2001 was slightly warmer than normal, and precipitation was below normal. The average temperature for 2001 was 12.4°C (54.3°F), which was above normal (12.0°C [53.6°F]). Precipitation for 2001 totaled 16.9 centimeters (6.6 inches), which was below normal (17.7 centimeters [6.98 inches]). Snowfall for 2001 totaled 38.4 centimeters (15.1 inches) compared to an annual normal snowfall of 39.1 centimeters (15.4 inches).

Ecosystem Monitoring and Ecological Compliance

Ecosystem monitoring and ecological compliance have multiple objectives that support completion of Hanford's waste management and environmental restoration mission:

- assuring Hanford Site operational compliance with laws and regulations including the *Endangered Species Act of 1973*, the *Bald and Golden Eagle Protection Act*, and the *Migratory Bird Treaty Act*
- providing data for environmental impact and ecological risk assessments
- providing maps and information useful for biological resource impact mitigation during facility expansion
- supporting Hanford Site land-use planning
- protecting natural resources within the DOE-operated portions of the Hanford Site including the DOE-managed portions of the Hanford Reach National Monument
- providing information useful to the tribes, natural resource stakeholders, and the public on the status of some of Hanford's most highly valued biological resources.



Chinook salmon use the Hanford Reach of the Columbia River as a spawning area in the fall. Surveys in 2001 indicated that the number of fall spawning fish in the Hanford Reach increased from the 2000 level.

Ecosystem Monitoring

The Ecosystem Monitoring Project monitors the status of plant and animal populations on the Hanford Site, maintains biotic inventory data, and assists in implementing ecosystem management policies. Rare plant populations and plant communities, spawning Columbia River fall chinook salmon, elk, and mule deer are monitored annually as part of the project.

Fall Chinook Salmon

In 2001, ~6,248 fall chinook salmon redds were observed in aerial surveys of the Hanford Reach of the Columbia River, an increase of 741 from 2000 and ~80% of the 1996 and 1997 totals. However, aerial surveys do not yield absolute redd counts because visibility varies, depending on water depth and other factors, and because the number of redds in high-density locations cannot be counted accurately.

Rocky Mountain Elk

Rocky Mountain elk did not inhabit the Hanford Site when it was established in 1943. Elk were first observed on the Fitzner / Eberhardt Arid Lands Ecology Reserve in 1972. Since that time, the herd has grown and now occupies portions of the Hanford Site, the U.S. Army's Yakima Training Center, and private land along Rattlesnake Ridge.

At the end of 2001 hunting season, the herd size was estimated at 484 animals.

The Washington Department of Fish and Wildlife has primary responsibility for management of the elk herd and works cooperatively with the U.S. Fish and Wildlife Service, which has primary land management responsibility for the Hanford Reach National Monument land that encompasses much of the Rattlesnake Hills elk herd range.

Mule Deer

Since 1993, systematic roadside observations of mule deer have been conducted during the post-hunting periods (December through January). The surveys are conducted to monitor trends in age and sex ratios of mule deer, examine trends in their relative abundance on the Hanford Site, and monitor the frequency of testicular atrophy. In 2001, mule deer fawn survival was about 30 fawns per 100 does, which is similar to other deer populations found in the shrub-steppe environment.

Plant Biodiversity Inventories

The Hanford Site contains biologically diverse shrub-steppe plant communities that have been protected from disturbance, except for fire, over the past 55 years. This protection has allowed plant species that have been displaced by agriculture and development in other parts of the Columbia Basin to thrive at Hanford. More than 100 rare plant populations of 31 different taxa are found on the Hanford Site.

In addition to rare plant populations, several areas on the Hanford Site are designated as special habitat types with regard to potential occurrence of plant species of concern listed by Washington State.

Surveys in 2001 continued to indicate increases in the numbers of Piper's daisy, a species of concern occurring in the 200 Areas. Populations of another species of concern occurring near the Columbia River, persistent sepal yellowcress, do not appear to have experienced significant recovery after declining as a result of the high Columbia River flow levels.

Maps showing the extent and distribution of the plant communities on the Hanford Site were updated in 2001 to reflect the changes in plant communities resulting from the wildfire in June 2000 and incorporate recently mapped riparian areas.



Since 1993, systematic roadside observations of mule deer have been conducted during the post-hunting periods (December through January). The surveys are conducted to monitor trends in age and sex ratios of mule deer and examine trends in their relative abundance on the Hanford Site. Surveys of mule deer help scientists evaluate the health of the mule deer population.



Surveys in 2001 continued to indicate increases in the numbers of Piper's daisy (shown in the photo), a species of concern. Populations of another species of concern occurring near the Columbia River, persistent sepal yellowcress, do not appear to have experienced significant recovery.



At least 47 plant species on or near the Hanford Site are listed as endangered, threatened, sensitive, or watch list by the Washington Natural Heritage Program.



The long-billed curlew is a state monitor species in Washington. The curlew is found on the site from early spring to mid-summer.

Ecological Compliance

The policies of DOE's Richland Operations Office require that all projects having the potential to adversely affect biological resources have an ecological compliance review performed before the project begins. This review assures that DOE is in compliance with the *Endangered Species Act* and the *Migratory Bird Treaty Act*.

Ecological compliance reviews also assure that other significant resources such as Washington State listed species of concern, wetlands, and native shrub-steppe habitats are adequately considered during the project planning process. Where effects are identified, mitigation action is prescribed. Mitigation actions can include avoidance, minimization, rectification, or compensation.

Since many projects occur during times of the year when plants are not growing, and the plants are difficult to identify or evaluate, each operational area (200-East, 200-West, all the 100 Areas, and the 300 Area) is surveyed each spring.

These baseline surveys provide information about habitat types and species inventories and abundance that can be used throughout the year to assess potential project impacts. At least 47 plant species on or near the Hanford Site are listed as endangered, threatened, sensitive, or watch list by the Washington Natural Heritage Program. Three of these species are also listed by the federal government as candidates for protection under the Endangered Species Act. Examples of the baseline survey maps are available at www.pnl.gov/ecology/ecosystem.

A total of 109 ecological compliance reviews were performed during 2001 in support of general Hanford activities. An additional 60 reviews were performed in support of environmental restoration activities. The total number of reviews prepared in 2001 (169) was similar to the number performed in 2000.

In 2001, 64 reviews were performed in the 200 Areas, 27 in the 300 Area, 26 in the 100 Areas, and 52 in other areas. They include the 400, 600, 700, Richland north, and former 1100 Areas.



DOE is in the process of evaluating the feasibility of retaining various historic structures on the Hanford Site, including the Hanford town site high school.



K-West Reactor, a contributing property, was recommended for mitigation within the Hanford Site Manhattan Project and Cold War Era Historic District.

Cultural Resources

The DOE Richland Operations Office established a cultural resource monitoring program in 1987. This program determines the impact of DOE policies on cultural resources and safeguards them from adverse effects associated with natural processes or unauthorized excavation and collection that violate federal laws.

Monitoring conducted during 2001 focused on Locke Island's erosion, archaeological sites with natural and visitor impacts, historic buildings and structures, and places with Native American burials. Surveys in 2001 recorded erosional losses of up to 1 meter (3.28 feet).

Eighty-six archaeological sites were monitored in 2001 to gather data associated with recreational use, visitor impact, and/or natural weathering processes.

Places with cemeteries or known human remains include locations that are sacred to local tribes. In 2001, all these places were monitored to document baseline conditions, determine whether wind or water erosion had

exposed human remains, assure that violations of federal laws were not present or ongoing, and monitor for violations of federal laws.

During 2001, 150 cultural resource reviews were requested and conducted on the Hanford Site to comply with Section 106 of the *National Historic Preservation Act*.

During 2001, the building mitigation project continued to implement the Programmatic Agreement for the Built Environment and the sitewide treatment plan. The final *History of the Plutonium Production Facilities at the Hanford Site Historic District, 1943-1990* was published in July 2002.

Public involvement is an important component of a cultural resource management program. To accomplish this, DOE developed mechanisms that allowed the public access to cultural resources information and the ability to comment and make recommendations concerning the management of cultural resources on the Hanford Site. These mechanisms were woven into draft public involvement procedures that include input provided by the public and Hanford Site staff over the last several years.



Tribal members assist DOE with cultural resource surveys, site form preparation, records management, and equipment use.

Stakeholder and Tribal Involvement

Many entities have a role in DOE's mission of environmental restoration, waste management, and protection of the Columbia River at the Hanford Site. Stakeholders include federal, state, and local regulatory agencies; environmental groups; regional communities and governments; and the public. Indian tribes and Nations also have a special and unique involvement with the Hanford Site and maintain a government-to-government relationship with DOE.

Several federal, state, and local regulatory agencies are responsible for monitoring and enforcing compliance with applicable environmental regulations at the site. The Hanford Natural Resource Trustee Council is another stakeholder. This council comprises federal trustees for Hanford natural resources, including the U.S. Fish and Wildlife Service, Bureau of Land Management, and National Oceanic and Atmospheric Administration. Local Indian tribes also are members of the council as are the Washington State Department of Ecology, Washington Department of Fish and Wildlife, and Oregon Department of Energy. It facilitates coordination and cooperation of trustees in mitigating impacts to natural resources that result from either hazardous substances releases within the site or remediation of those releases.

The Role of Indian Tribes

The Hanford Site is located on land ceded to the United States government by the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation in the Treaties of 1855. These tribes, as well as the Nez Perce Tribe, have treaty fishing rights on portions of the Columbia River.

The Wanapum People are not a federally recognized tribe, but have historic ties to the Hanford Site as do the Confederated Tribes of the Colville Reservation, whose members are descendants of people who used the area now known as the Hanford Site.

The Hanford Site's environment supports a number of Native American foods and medicines and contains sacred places important to tribal cultures. The tribes hope to safely use these resources in the future and want to assure themselves that the Hanford environment is clean and healthy.

American Indian Tribal governments have a special and unique legal and political relationship with the government of the United States, defined by history, treaties, statutes, court decisions, and the U.S. Constitution. In recognition of this relationship, DOE and each tribe interact and consult directly.

Tribal government representatives from the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe participate in DOE-supported groups such as the State and Tribal Government Working Group, the Hanford Natural Resources Trustee Council, the Hanford Site Groundwater/Vadose Zone Integration Project, the Hanford Cultural Resources Program. They also review and comment on draft documents. Both the Wanapum People and the Confederated Tribes of the Colville Reservation also are provided an opportunity to comment on documents and participate in cultural resource management activities.



In July 2000, the Wanapum People built a tule mat lodge at Priest Rapids of the long green stems of tule, a wetland plant, harvested from the slow current marshes along the Columbia River.

The DOE American Indian and Alaska Native Tribal Government Policy guides DOE's interactions with tribes for Hanford plans and activities.

Members of the Confederated Tribes of the Umatilla Indian Reservation, Yakama Nation, Nez Perce Tribe, and Wanapum People were actively involved in the cultural resources program during 2001. Each tribe was involved in deciding DOE's cultural resource program work scope, budget, and schedule. Monthly meetings on cultural resource issues provided a venue for the exchange of information between DOE, tribal staff members, and site contractors about projects and work on the Hanford Site.

During 2001, one member of the Wanapum People assisted with cultural resource surveys, site form preparation, records management, and equipment use. Interviews were conducted with Wanapum elders about sites that have traditional significance on the Hanford Site.

Public Participation

Citizens of the state of Washington and neighboring states may influence Hanford Site cleanup decisions through public participation activities.

The public is provided opportunities to contribute their input and influence decisions through many forums, including Hanford Advisory Board meetings, Tri-Party Agreement activities, *National Environmental Policy Act* public meetings covering various environmental impact statements, and other involvement programs.

The Tri-Party Agreement provides a means for Hanford to become compliant with environmental regulatory requirements.

The Hanford Site Tri-Party Agreement Public Involvement Community Relations Plan outlines how public information and involvement activities are conducted for Tri-Party Agreement decisions. The Washington State Department of Ecology, DOE, and EPA developed and negotiated the plan with input from the public. The plan was approved in 1990.

The plan is updated as needed. The most recent revision occurred in 2002. The plan can be found on the Internet at www.hanford.gov/crp/toc.htm.

A mailing list of about 3,300 individuals who have indicated an interest in participating in Hanford Site decisions is maintained. The



Citizens of the state of Washington and neighboring states may influence Hanford Site cleanup decisions through public participation activities and public meetings.

mailing list also is used to send topic-specific information to those people who have requested it. Information is provided on upcoming decisions to elected officials, community leaders, special interest groups, and the media.

To inform the public of upcoming opportunities for public participation, the *Hanford Update*, a synopsis of all ongoing and upcoming Tri-Party Agreement public involvement activities, is published bimonthly. In addition, the *Hanford Happenings*

calendar highlights Tri-Party Agreement meetings and comment periods. It is distributed monthly to the entire mailing list.

To allow Hanford stakeholders and others to access up-to-date information, documents from the Tri-Party Agreement's Administrative Record and Public Information Repository are available on the World Wide Web at <http://www2.hanford.gov/arpir>.

The public can obtain information about cleanup activities via a toll-free telephone line (800-321-2008). Members of the public can request information about any public participation activity and receive a response by calling the Office of Intergovernmental, Public, and Institutional Affairs (DOE Richland Operations Office) at (509) 376-7501.

Also, a calendar of public involvement opportunities can be found on the Internet at www.hanford.gov/calendar/.



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1. How do you use the information in this summary?

- To become more familiar with Hanford monitoring
- To send to others outside the Tri-Cities area
- To help me make a decision about moving to the Tri-Cities
- To prepare for public meetings on Hanford cleanup
- Other (please explain) _____

2. What parts of the summary do you use?

- Hanford Site overview/mission
- Environmental research
- Environmental compliance
- Environmental monitoring
- Potential radiological doses from Hanford operations
- Quality assurance
- Public participation
- Current issues and actions
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- enough detail?
- too much detail?
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- Hanford Site contractor
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- DOE
- Member of the public
- University
- State agency
- Member of Native American Nation
- Industry
- Federal agency

6. Other Comments?

Thank you!



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