Hanford - Areas 100, 200, 300, 1100
Richland, Washington
Region 10
WA3890090075

Site Exposure Potential

The U.S. Department of Energy's (DOE) Hanford site was established in 1943 to conduct research and development in nuclear energy technology. The entire site occupies 1,500 km^2 and contains 355 inactive waste disposal locations. Due to the large area and number of disposal sites, four subareas have been designated: Areas 100, 200, 300, and 1100 (Figure 1). Area 100 is adjacent to the Columbia River in the northern section of the Hanford site and is the farthest upstream of the four sites. This site contains nine inactive nuclear reactors that produced plutonium and generated electricity. Area 200 is in the middle of the Hanford site and is used by DOE for the recovery of plutonium and the

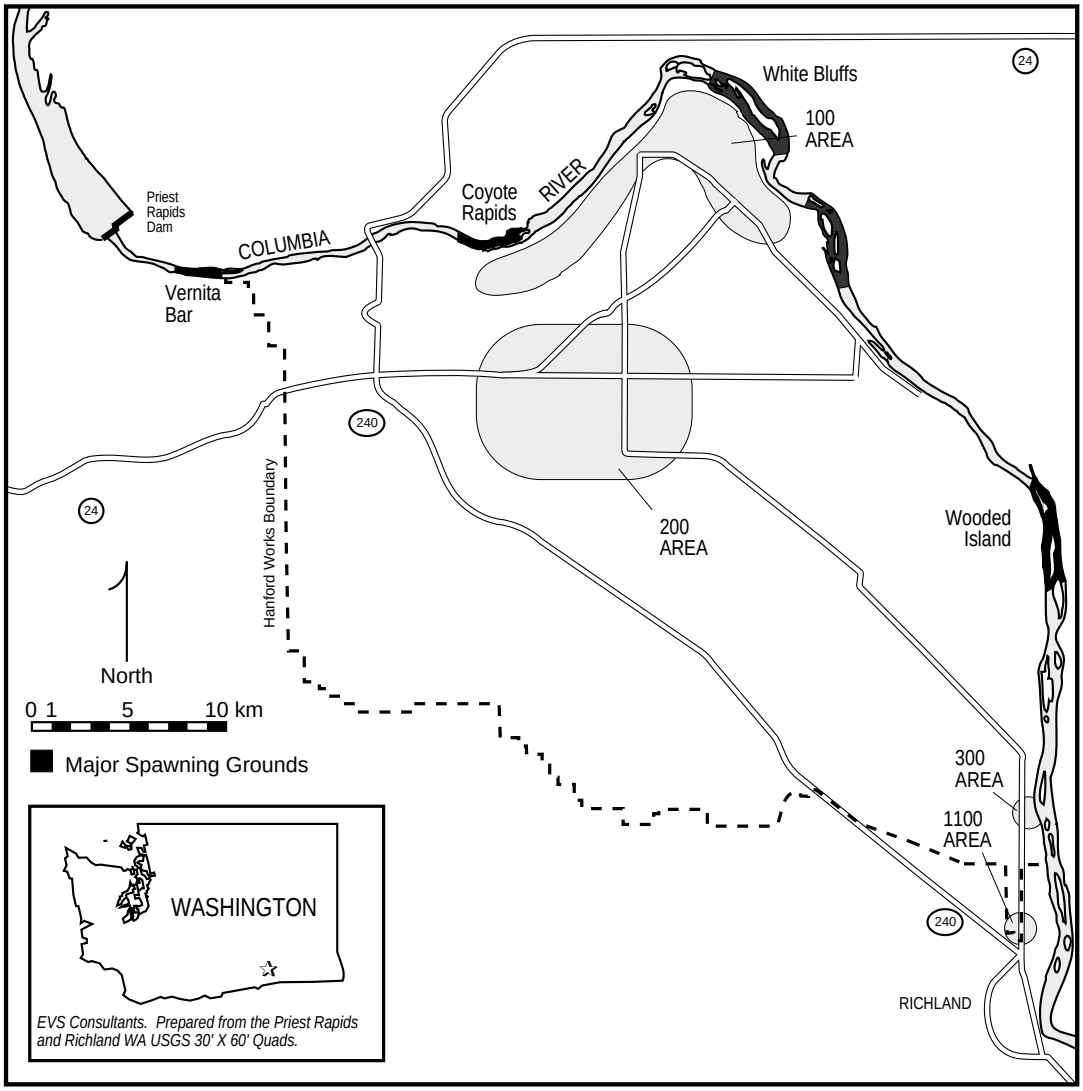

Figure 1. Waste disposal locations and salmon spawning grounds at Hanford.

processing and storing of waste materials. Area 300 is adjacent to the Columbia River in the southern portion of the site and has been used by DOE to fabricate nuclear reactor fuel. Area 1100 is adjacent to the Columbia River just south of Area 300 and is used by DOE for equipment maintenance operations (EPA 1987).

The major contaminant transport pathway from the Hanford site to the Columbia River is groundwater flow. Surface water runoff is negligible due to low rainfall, high evaporation, relatively level topography, and high infiltrative rates and capacity.

Site-Related Contamination

The contaminants of concern in Area 100 are radionuclides and inorganic and organic contaminants. An estimated 3.3 billion m^3 of solid and liquid waste were disposed of in more than 110 waste disposal locations in Area 100. The disposal locations and plumes of contaminated groundwater cover 28.5 km^2 (EPA 1987). Strontium-90 and chromium were monitored as indicators for groundwater transport of contaminants. Low levels of strontium-90 were detected both in the groundwater beneath Area 100 and in the Columbia River. Chromium has also been detected in the groundwater at levels two orders of magnitude above AWQC for the protection of freshwater aquatic life (Table 1).

Table 1. Maximum concentrations of contaminants near Area 100 (EPA 1987); AWQC for the protection of freshwater aquatic life (EPA 1986).

	Groundwater		Columbia River		AWQC	
Contaminant	Upgradient	Downgradient	Upgradient	Downgradient	Acute	Chronic
strontium-90	<0.753 pCi/l*	12.5 pCi/l*	0.34 pCi/l*	28 pCi/l**	N/D	N/D
chromium	10.0 μg/l	1,560.0 μg/l	N/A	N/A	16	11

N/A: Not available
N/D Not determined
* pCi/l : picocuries per liter. A curie is the official unit of radioactivity, defined as 3.70×10^{10} disintegrations per second. This decay rate is nearly equivalent to that exhibited by one gram of radium in equilibrium with its disintegration products. A picocurie (pCi) is 10^{-12} curie.

The contaminants of concern to NOAA in Area 200 are radionuclides and inorganic and organic contaminants. An estimated 765 million m^3 of radioactive, mixed, and hazardous solid and dilute liquid wastes were disposed of in over 230 waste disposal locations in Area 200. The disposal locations and plumes of contaminated groundwater cover 557 km^2 (EPA 1987). Releases to the groundwater from Area 200 have been demonstrated using tritium, iodine-129, uranium, cyanide, and carbon tetrachloride (Table 2).

Table 2. Observed releases to groundwater from Area 200 (EPA 1987).

Contaminant	Background	Downgradient
tritium	<320.0 pCi/l	1,600,000.0 pCi/l
		22,000.0 pCi/l
		35,400.0 pCi/l
iodine-129	0.000094 pCi/l	4.89 pCi/l
uranium	1.06 pCi/l	14,900.0 pCi/l
		2,748.0 pCi/l
cyanide	<10.0 μg/l	405.0 μg/l
carbon tetrachloride	<10.0 μg/l	2000.0 μg/

* pCi/l : picocuries per liter. A curie is the official unit of radioactivity, defined as 3.70×10^{10} disintegrations per second. This decay rate is nearly equivalent to that exhibited by one gram of radium in equilibrium with its disintegration products. A picocurie (pCi) is 10^{-12} curie.

Similarly, tritium and iodine-129 have been used to demonstrate contaminant movement from Area 200 to surface water by comparing upstream and downstream concentrations (Table 3).

Table 3. Surface water data from Area 200 (EPA 1987); units in pCi/l.

Contaminant	Background	Downgradient
iodine-129	3.3×10^{-6}	63.0×10^{-6}
	1.04×10^{-5}	16.1×10^{-5}
tritium	107.0	60,600.0
	119.0 (mean)*	165.0 (mean)*

* Comparison of the 75 downstream samples (mean = 165) to the 75 upstream samples (mean = 119) using a one-tailed T-Test, indicated that there is a 95% probability that the downstream sample mean is significantly higher than the upstream. Statistical analyses performed by DOE in 1985 and 1986 of upstream-downstream sampling data showed similar results.

The contaminants of concern in Area 300 are radionuclides and inorganic and organic contaminants. An estimated 20.6 million m^3 of radioactive, hazardous, and mixed waste materials have been placed in 14 disposal locations. The disposal locations and plumes of contaminated groundwater in Area 300 cover 13 km^2. Uranium was used as an indicator constituent in Area 300, and its measurement has verified groundwater contamination beneath the site. Levels ranged from 20 pCi/l to 42 pCi/l. Releases of uranium to springs along the river bank have also been observed. The springs discharge into the Columbia River (EPA 1987).

The contaminants in Area 1100 threatening natural resources are inorganic and organic contaminants. An estimated 56,775 liters of waste battery acid were disposed of in an unlined sand pit. Also, an unknown amount of waste antifreeze was placed in a 19,000-liter underground tank (EPA 1987).

NOAA Trust Habitats and Species in Site Vicinity

The Columbia River is a large, low-gradient riverine system. Flow rates vary due to power production from the Priest Rapids Dam, 20 km upstream of the site. River width in the Hanford Reach ranges from 300 to 600 meters with an average depth of eight meters. Daily fluctuations in depth caused by release from the Priest Rapids Dam can be as much as three meters just below the dam and 1.5 meters at the Hanford site. The upper part of the Hanford Reach, near Areas 100 and 200, is a riffle with gravel/cobble substrate; the benthic invertebrate community in this section is relatively diverse. In contrast, the lower section of the Hanford Reach near Richland is more pool-like with a silt substrate and therefore a less diverse invertebrate community (Cushing 1988).

The Columbia River is the largest salmonid river on the West Coast of the United States. Steelhead trout and chinook, coho, and sockeye salmon use the Hanford Reach adjacent to the site as spawning ground, nursery area, foraging area, and migratory corridor (Table 4). The Hanford Reach provides the only spawning grounds in the river for fall chinook salmon and steelhead trout (Battelle 1980; Battelle 1985). Spawning in Hanford Reach has increased five-fold since 1960. This increase is attributed to the loss of upstream spawning grounds after the construction of the Priest Rapids Dam. Several spawning grounds near Area 100 are susceptible to contaminant discharge from Hanford.

Table 4. NOAA trust resource use of the Hanford Reach of the Columbia River (EPA 1987).

Species	Spawning Area	Nursery Area	Adult Area	Migration Route
American shad	X*	X*		
chinook	X	X	X	X
coho	X	X	X	X
sockeye	X	X	X	X
steelhead	X	X	X	X
white sturgeon	X	X	X	

* unconfirmed

These spawning grounds include White Bluffs and Coyote Rapids near Area 100, and Wooded Island downstream of Area 100. Wooded Island is also susceptible to contaminant discharge from Area 200. The Hanford Reach also provides critical nursery and foraging habitat for juvenile fall chinook salmon and steelhead over the entire year. Two hatcheries on the Hanford Reach release as many as 20 million juvenile chinook salmon and steelhead trout in the Hanford Reach each year (Battelle 1985).

American shad and white sturgeon have also been reported in the Hanford Reach (Gray and Dauble 1977). American shad probably use the Reach as spawning ground and nursery but this has not been confirmed; this species has not been found in great abundance. White sturgeon are fairly abundant and use the Hanford Reach as spawning ground, nursery area, and adult habitat. However, it is questionable whether sturgeon in the Reach are anadromous, since most populations above the Bonneville Dam are considered landlocked (Battelle 1980).

Response Category: Federal Facility

Current Stage of Site Action: RI/FS Workplan

EPA Site Manager

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References

Battelle Pacific Northwest Laboratories. 1980. Aquatic and Riparian Resource Study of the Hanford Reach, Columbia, River, Washington. Seattle: U.S. Army Corps of Engineers.

Battelle Pacific Northwest Laboratories. 1985. Anadromous Salmonids of the Hanford Reach, Columbia River: 1984 status. Washington, D.C.: U.S. Department of Energy.

Blaylock, B. G. and J. R. Trabalka. 1978. Evaluating the effects of ionizing radiation on aquatic organisms. Advances in Radiation Biology 7:103-152.

Cushing, C. E., Environmental Assessment, Battelle Northwest Laboratories, Richland, Washington, personal communication, January 13, 1988.

DOE. 1986. Draft Phase I Installation Assessment of Inactive Waste-Disposal Sites at Hanford, Vol. I & II. Washington, D.C.: U.S. Department of Energy.

EPA. 1987. Hazardous Ranking System Scoring Package for 200 Area. Seattle: U.S. Environmental Protection Agency, Region 10.

Gray, R.H. and D.D. Dauble. 1977. Checklist and relative abundance of fish species from the Hanford Reach of the Columbia River. Northwest Science 51(3), August 1977.